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Economic Impact of Environmental Controls on the Fruit & Vegetable Canning & Freezing Industries

PART III
IMPACT ANALYSIS

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A Report to
Council on Environmental Quality

P-585
November, 1971

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Agri Division
Dunlap and Associates, Inc.
Manhattan, Kansas

ECONOMIC IMPACT OF ENVIRONMENTAL CONTROLS ON THE FRUIT AND VEGETABLE CANNING AND FREEZING INDUSTRIES

PART III

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The report concerns the economic impact of ~~the~~ pollution control measures on the fruit & vegetable canning + freezing industries.

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PREFACE

This volume is one in a series of reports developed by the Agri Division, Dunlap and Associates, Inc. for the Council on Environmental Quality as part of a comprehensive study entitled: Economic Impact of Environmental Controls on the Fruit and Vegetable Canning and Freezing Industries. The set of reports include:

Part I: Executive Summary

Part II: Industry Structure

Part III: Impact Analysis

Part IV: Statistical Supplement

These reports complete the program of work as planned and specified under Contract PA 71-53.

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EXECUTIVE SUMMARY

ECONOMIC IMPACT OF ENVIRONMENTAL CONTROLS ON THE FRUIT AND VEGETABLE CANNING AND FREEZING INDUSTRIES

I. INTRODUCTION

In an effort to reverse the progressive deterioration of the environment, currently available pollution abatement technology is being improved with intensified research and development efforts. The impact of such intensification of environmental management is being seen in terms of reduction of environmental degradation associated with the disposal of industrial wastes throughout the nation.

However, the implementation of environmental controls normally results in added costs and may result in economic and locational adjustments within these industries. It is the purpose of this study to examine these adjustments as they relate to the fruit and vegetable processing industries in terms of costs, capital requirements, profits, industry structure and location, employment, product prices and regional and national economic impacts.

The general approach used in this study was to initially analyze and describe the characteristics of supply, demand, price and operating requirements of these industries and given this base, evaluate the microeconomic relationships among representative firms within the fruit and vegetable processing industries as a first step; and, second to then project macroeconomic impacts at the industry level based on the resulting microeconomic impact relationships which were developed.

Throughout this study, excellent cooperation and assistance was obtained from Contract Representatives of the Environmental Protection Agency and from industry trade associations, particularly the National Canners Association and the Frozen Food Institute who contributed detailed information concerning these industries.

II. DEMAND CHARACTERISTICS

The demand for canned and frozen fruits and vegetables centers on a nationwide market served mainly through retail food stores with secondary outlets being institutional food purveyers and further processors who manufacture prepared dinners and other convenience foods.

A. Products and Substitute Products

This study was restricted to a consideration of basic fruit and vegetable canning and freezing. Preserves, jams, jellies and frozen specialty products were not included. The specific products selected for study account for over 80 percent of the total volume processed.

The principal substitutes for canned and frozen fruits and vegetables are fresh fruits and vegetables. Overall, the degree of substitutability between fresh and processed fruit and vegetables is not close.

B. Size, Location and Relative Importance of Markets

Although there is some carryover of the pack of canned and frozen fruits and vegetables from one packing season to the next, total volume packed is the best indicator of aggregate demand for these products.

Total pack of canned vegetables in 1970-71 was approximately 325,596,000 cases (24/303 can equivalent). Volume packed has remained relatively stable during the past 10 years. Four products (tomato products, sweet corn, green beans and green peas) account for over 70 percent of the total pack.

Canned fruits and fruit juices pack, 1970-71, was approximately 208,113,000 actual cases. Volume has increased slightly during the past ten years, up from approximately 138,000,000 cases in 1961-62. Four fruits (peaches, apple sauce, pineapple and fruit cocktail) accounted for over 50 percent of the total pack.

The pack of frozen vegetables has risen steadily since 1961, from 2.1 billion pounds in that year to nearly 4.5 billion pounds in 1970-71. Potato products represented over half of the total tonnage frozen with peas, corn and green geans accounting for an additional 17 percent of the total pack.

Frozen fruits and fruit juices do not show the consistent upward trend which characterizes the pack of frozen vegetables. Pack of frozen fruits has been relatively stable near 700 million pounds.

Demand changes - specific products - Although there have been substantial shifts in the demand for specific canned and frozen fruits and vegetables in the last 10 years, analysis of these relationships show certain identifiable patterns.

* There is a trend, in both canned and frozen fruits and vegetables, for increased demand for convenience products, e.g., canned and frozen potato products, etc.

* There is a definite trend toward increased consumption of fruit juices, both canned and frozen.

* Tomato catsup and chile sauce are gaining rapidly in demand.

Per capita consumption - Some very distinct changes have occurred in patterns of consumption of fruits and vegetables by the American consumer in the past two decades.

* Fruits and juices - Per capita consumption of canned and frozen fruits and juices increased steadily from 43 pounds in 1950 to 67 pounds in 1970 and is expected to reach approximately 75 pounds by 1980.

* Vegetables - Percapita consumption of canned and frozen vegetables has increased gradually over the past 20 years, from about 83 pounds in 1950 to 115 in 1970 and further increases to approximately 128 pounds per capita are projected by 1980.

International trade - Exports of canned vegetables from the United States are not of significant volume, in relation to total pack, for any item. However, the export market accounts for 9 to 15% of canned fruit cocktail, cherries, peaches and pineapple. Export markets take 41.5 percent of the U. S. hot pack orange juice volume, 18.5 percent of the canned grapefruit juice pack. Frozen concentrated orange juice is the principal frozen product exported. Exports of frozen vegetables are of little importance.

Canada and Western Europe are the principal export markets.

Imports of processed fruits, vegetables and juices are primarily tropical or subtropical products not produced in the United States. However, imports of canned apple juice and pear juice, canned pineapples and juices, frozen strawberries and blueberries, tomato products and mushrooms are imported in substantial quantities and do compete with similar products processed in the United States.

Government purchases are an important element of total demand for canned products and account for 4 to 6 percent of the total pack of canned fruits and vegetables and 10 to 12 percent of the total canned juice pack. Governmental use accounts for 2-3 percent of the total pack of frozen fruits and vegetables and slightly over one percent of the frozen juice pack.

C. Recent Trends in Demand and Price

Demand trends - A more detailed examination of total industry demand shows that the demand for certain specific products is advancing while for others demand is declining. With the exception of tomato juice, apples, lima beans and strawberries, the demand trend for processed fruits and vegetables has been either constant or increasing over the past ten years.

Price trends - Prices of canned and frozen fruit and vegetable products vary from year to year in response to current year pack and year-end carryover stocks. In addition, they are subject to exogenous economic pressures related to production and processing costs and purchasing power of consumers. During the past five years prices have generally trended upward with the exception of corn, lima beans, tomato juice and cherries.

D. Distribution Systems

Eighty-four percent of the canned fruits and vegetables move into use through retail food stores. Retail chains handle 49 percent directly and wholesale or cooperative buying groups 35 percent. Sixteen percent move through institutions, government, and to further processing.

Frozen products follow a similar pattern except a lesser percentage moves directly to the consumer while 28 percent goes to further processing and 15 percent to government and institutions.

E. Market Competition

Although the fruit and vegetable canning and freezing industries are characterized by the existence of large, multi-plant, multi-product firms, the industry is, nevertheless, highly competitive. There are a large number of small canners and freezers and the industry is faced with the necessity of selling a high proportion of its total pack to large, national food chains. Plants and firms located in any region are potential competitors to those producing the same product lines in all other regions.

F. Governmental Influences

The principal governmental influences relating to the fruit and vegetable industries are concerned with product and container standards, plant and product inspection and labeling requirements. There is little direct governmental influence over the marketing of these products.

III. SUPPLY CHARACTERISTICS OF THE FRUIT AND VEGETABLE INDUSTRY

The fruit and vegetable canning and freezing industries are supply-oriented in that, because of the perishable nature of the raw products, location of processing plants is largely dictated by the location of raw product production.

The diversity of products processed and seasonality of production of basic fruit and vegetable crops results in a nation-wide network of canning and freezing plants. However, major areas of processing are found as certain areas offer the greatest potentials for fruit and vegetable production.

A. Types and Locations of Raw Materials

Vegetables for Processing - Production of vegetables for processing is widely dispersed throughout the United States and commercial production is found in every state. However, production is concentrated (51% of total) in the West, mainly in California and the Pacific Northwest, with the North Central Region (31%) being the other major producing area.

Fruit Production - Nearly every state is a commercial producer of some kind of fruit, but production is concentrated in relatively few states. Seven states (California, Florida, Washington, New York, Michigan, Oregon and Pennsylvania) accounted for 88 percent of the total U. S. fruit tonnage, 1967-1969.

B. Number and Location of Firms/Plants

Fruit and Vegetable Canning Plants - The number of canning plants in the United States decreased from 1630 in 1958 to 1223 in 1967, a decline of 25 percent. There has been some slight shift in relative regional importance with the West and South gaining slightly over the East and Midwest. The leading states are California, 170; New York, 106; Wisconsin, 91; Florida, 69; and Maryland, 65. Based on historical trend, 800 plants are projected for 1980.

Fruit and Vegetable Freezing Plants - In contrast to fruit and vegetable canneries, the number of freezing plants increased from 303 in 1958 to 650 in 1963 but decreased to 607 in 1967 -- down 6.5 percent and is projected to decrease to 505 by 1980. The greatest number is in the West (32.6%) and the remainder are evenly distributed throughout the United States. California has the most plants (85), followed by New York (47), Washington (46), Illinois (36), Michigan (34) and Oregon and Pennsylvania.

C. Characteristics of Fruit and Vegetable Canning and Freezing Plants

Size of firms - A detailed analysis was made of the volume packed of a selected sample of 598 canners and 231 fruit and vegetable freezing firms.

Canners - Over a third of the firms analyzed (35.7%) would be considered as small canners, with an annual pack of less than 250,000 cases. At the other end of the range, 28.6 percent packed over 1,000,000 cases and 19 percent packed over 5,000,000 cases each.

Freezers - Approximately 30 percent of all freezers analyzed would be classed as small, with annual volumes of less than 5 million pounds. However, 46.6 percent would be considered large (annual volume in excess of 20 million pounds) and 22.9 percent had annual packs of over 100 million pounds.

Concentration of Processing Operations - The canning industry is characterized by a large number of firms, but a few major canners pack a high percentage of the total volume. Consequently a large number of small canners share a small segment of the total market. For the major canned commodities the largest third process approximately 80% of the product; the middle third processes approximately 15% of the product; and the smallest third processes approximately 5% of the product.

Although similar data were not available for freezing, it is believed that similar concentration exists in that industry.

Single Plant vs. Multiplant Firms - Over 85 percent of the canners in the United States are single plant firms. Of the remainder (14.9%), the two largest firms operated 31 plants each, one firm had 24 plants, two had 17 plants and one had 16 plants.

Eighty-two percent of the freezers were single plant firms. The largest firm had 9 plants, the second largest 8, third 7 and the other two large firms had 6 plants each.

Single Product vs. Multiple Product Plants - Most canners were multiple product plants, 64.4 percent packing more than one product.

The same situation existed for freezers, where 57.5 percent were multiple product operations and 20 percent packed 4 or more products.

Diversified vs. Specialized Plants - Primary products (basic fruits, vegetables and juices) represented 90 percent of the total value of gross sales of fruit and vegetable freezing plants.

Stage in Production Process - All plants considered in this analysis were primary canners or freezers of fruits and vegetables. No secondary (reprocessing) activities were considered.

Degree of Integration - There is only a small degree of vertical integration (either forward or backward) in the fruit and vegetable processing industries. Only about 8 percent of canned fruits and vegetables and 9 percent of the frozen products were produced on land owned or rented by processors.

D. Employment

Fruit and vegetable canners and freezers are major employers of labor in the areas in which they operate. Further, they employ a high proportion of low-skilled workers in relation to total employment in the industry.

Employment by canners dropped from 108,400 in 1958 to 100,000 in 1967, a decline of 7.7 percent. At the same time, employment per plant increased from 66 to 82.

Employment by freezers in the 1958-67 period increased from 39,500 to 64,500, a gain of 63 percent. Average number of employers per plant increased from 93 in 1958 to 106 in 1967.

E. Capacity and Utilization of Capacity

It is recognized that appreciable excess capacity normally exists in both the canning and freezing industry. Utilization of capacity is generally higher in larger plants and in intensive, commercial production areas. Due to the fact that there is substantial year-to-year variation in the production of fruits and vegetables, 10-20 percent standby capacity is desirable. However, the only definitive study made showed utilization rates in Southern plants at 57 percent by canners and 74 percent for freezers.

F. Industry Segmentation

For the purposes of this study the canning and freezing industries were segmented by size. A "large" plant represents the average size in the largest third of the industry and approximately 80 percent of total volume; the "medium" size plant, the middle third and 15 percent of total volume; and the "small" plant, the smallest third and 5 percent of the volume.

IV. METHODOLOGY

The economic impact of pollution abatement costs on the fruit and vegetable canning and freezing industry can affect different sized plants in different ways. Economies of scale in processing costs as well as pollution abatement cost will lead to a differential impact on individual firms. A microeconomic evaluation of plants within the fruit and vegetable processing industry was conducted to assess probable impacts within the industry. From this base of information, overall impacts on the industry were projected.

A. Analytical Approach

For this study an economic-engineering approach was used to provide costs and revenue situations for representative processing plants. A 20-year planning horizon was used to simulate operations, both with and without internalized pollution abatement controls.

A series of operating situations for representative plants were simulated based on volume of operation, level of technology, level of capacity utilization, number of products and length of operating season. All these assumed operating conditions will affect the profitability of a processing plant and its ability to withstand pollution abatement costs.

The economic performance of individual plant operations was evaluated using the technique of discounted economic cash flows and internal rate of return analysis. This analytical technique is widely used in investment feasibility analyses and is appropriate for purposes of this study to assess economic impacts of proposed additional investments in pollution abatement facilities.

The internal rate of return, as a measure of investment feasibility, provides a "present value" comparison of current and future costs and income streams resulting from a plant operation. In essence, the internal rate of return is the discount rate which makes the "present value" of money invested in a given project over a period to time equal to the "present value" of money received over the length of the project.

This analytical technique by-passes the many problems of depreciation assumptions, etc. that would be necessary in an analysis of present unit cost of processing operations both with and without pollution abatement controls.

B. Water Pollution Abatement Costs

Water pollution abatement costs used in this study were provided by the CEQ. They were calculated with a computer based model developed to estimate both investment capital and operating capital required by the nation's industries to attain water pollution control standards. These "standards" are defined as equivalent of secondary treatment.

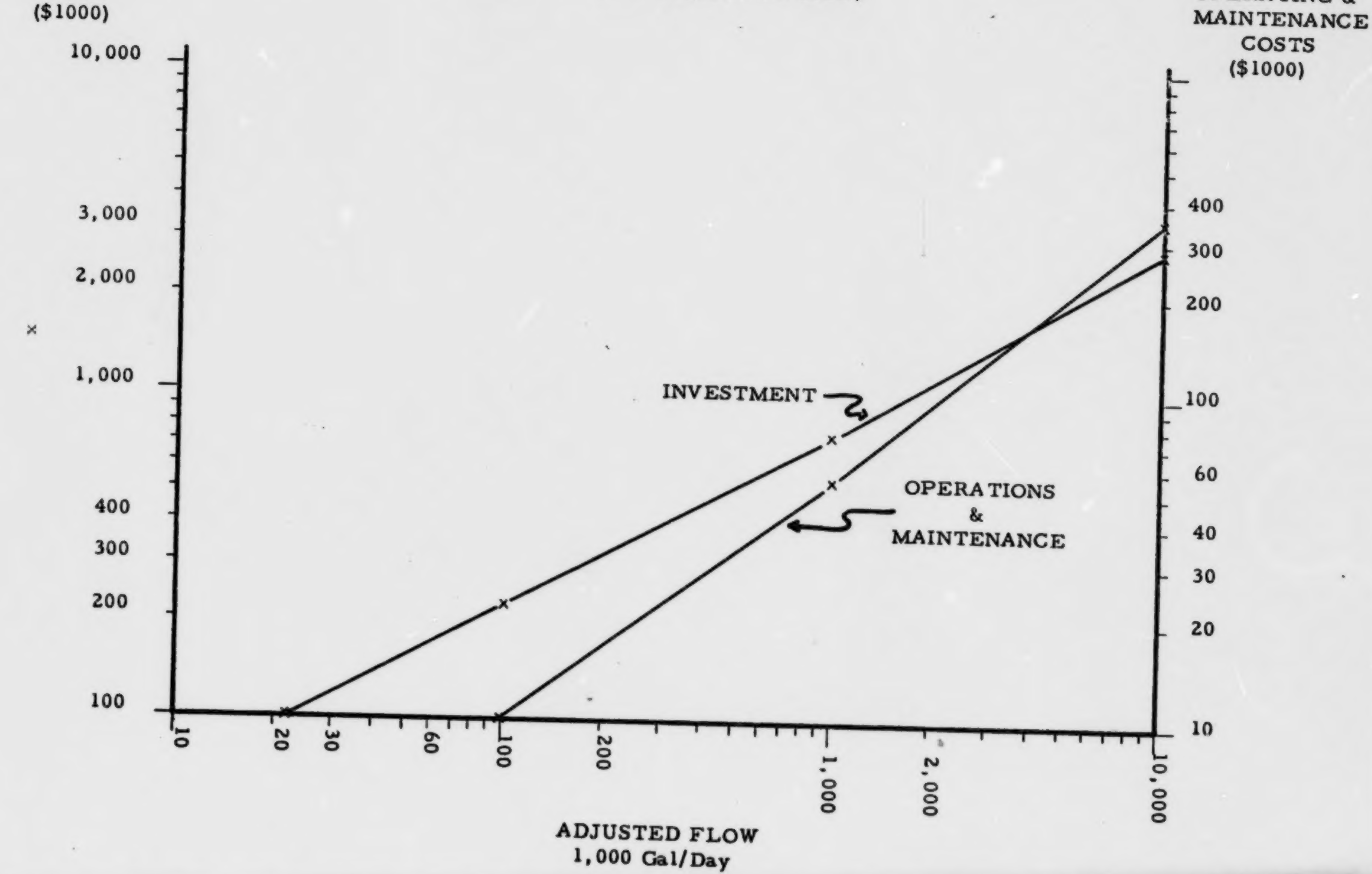
The configuration for a water plant to serve a fruit and vegetable processing plant is based on the following technology:

Method	Percent of Wasteflow Processed
Equalization	50
Flotation	100
Sedimentation	100
Biological stabilization	140

The actual flow of waste water was calculated by the kind of product processed and the number of cases processed per day. The actual flow of waste water was "adjusted" by a scaling factor of 2 to the .6 power to account for level of pollutants in waste water from the fruit and vegetable industry.

The adjusted flow was used to derive the appropriate capital investment and operation and maintenance cost from the relationship shown in Exhibit 1. The Council on Environmental Quality recognizes these costs are subject to variation under alternative conditions and established a reasonable range of -30 percent to + 30 percent.

Exhibit 1. Estimated Pollution Abatement Costs by Unit of Water Flow (adjusted) for Fruit and Vegetable Processing Plants.
(Full Logarithmic Scale)



V. INDUSTRY ANALYSIS

Economic cash flows were developed for major product lines under alternative conditions. Wherever data would allow, cash flows were developed for representative plants with an annual volume equal to the industry average for the largest third, middle third and smallest third plant groupings. Average volumes for the representative plants amounted to 80 to 200 cases per hour for the small plants, 170 to 400 cases per hour for the middle sized plants and 600 to 1,500 cases per hour for the large plants.

A. Size of Firms

Volume of production by type of plant proved to be a major factor in the level of returns. Large plants consistently proved to have higher returns than medium, or small size plants. For example, the internal rate of return for the multiproduct pea and corn canning plant was calculated at 50 percent for the large, 18 percent for the medium and 7 percent for the small. Data used for different product lines came from different sources, thus the rates of return should not be used to compare one product line with the second. The relative impact of size on various product lines was, however, comparable.

B. Impact of Other Variables

Capacity - The fruit and vegetable processing industry is currently operating at a level less than capacity. In the South the utilization rate was estimated at 57 percent for the canning industry and 74 percent for the freezing industry. Nation-wide the capacity is recognized at less than 75 percent. The rate of return drops sharply as the level of operating capacity is reduced -- on the average from 25 to 50 percent when operating capacity was reduced from 100 percent to 75.

Length of operating season - Because raw product availability is limited to specific short seasons, a single line plant may operate for as little as two months while other multiproduct firms may operate for as long as nine months. The effect of a longer season may be gained by operating at two or even three shifts. The longer season a plant can operate, the analysis shows, the more efficient it becomes.

Level of technology is difficult to assess in the fruit and vegetable industry. Many of the plants are relatively old, but throughout their useful life new equipment is added or used to replace that which is old or technologically obsolete. Many plants have been located at the same site for 20 to 40 years. As a result, most plants in the industry are a combination of old and new equipment. Generally, the newer equipment installed represents a higher level of technology than the old.

Even though capital investment costs are considerably lower in the older plants, higher operating cost generally offsets the advantage and results in a lower rate of return than newer plants. For a large plant with no pollution abatement facilities, returns are reduced from 42 percent to 33 percent for prevalent technology and 29 percent for old technology. A similar pattern exists for medium size plants, but older small plants perform at about the same level as the new plants. In other words, the older small plants are able to compete reasonably well with the newer ones.

C. Sensitivity Analysis of Pollution Abatement Cost

The impacts of pollution abatement costs at the micro level were evaluated, in part, by increasing revenues for the firm with abatement costs, to the level where the firm was operating with the same internal rate of return as experienced before pollution control. In effect this demonstrates the percent increase in revenues (or prices) required to cover the pollution abatement costs for a given firm.

The impact of pollution abatement costs were analyzed for each product grouping and a sensitivity analysis conducted for each. The analysis conducted on the corn and pea canning plants is shown on Exhibit 2 for illustrative purposes. Various increases in revenue were developed, then the rates of return were interpolated to identify the new price level which would provide sufficient revenue to offset the abatement cost. For the large corn and peas plant a 6.3 percent increase in product revenue is required, 8.6 for the medium plant and 11.0 percent for the small.

For the sensitivity analysis the pollution abatement costs were altered by 130 for the upper bound and 70 for the lower bound. This was for both investment cost and operation and maintenance cost. The revenue increase for the large plant under these conditions ranges from 4.4 to 8.1 percent. For the medium size plant the range is 6.1 to 10.3 percent and for the small the range is 7.7 to 12.6.

For those plants that must provide their own facilities, the following may be considered representative:

		Percent Required Price Increase		
Plant Grouping	Percent of Total Volume	Low	Average	High
Large	80	3.9	5.5	7.5
Medium	15	4.6	6.4	8.1
Small	5	7.2	9.6	11.6
Weighted average increase required		4.8	5.8	7.8

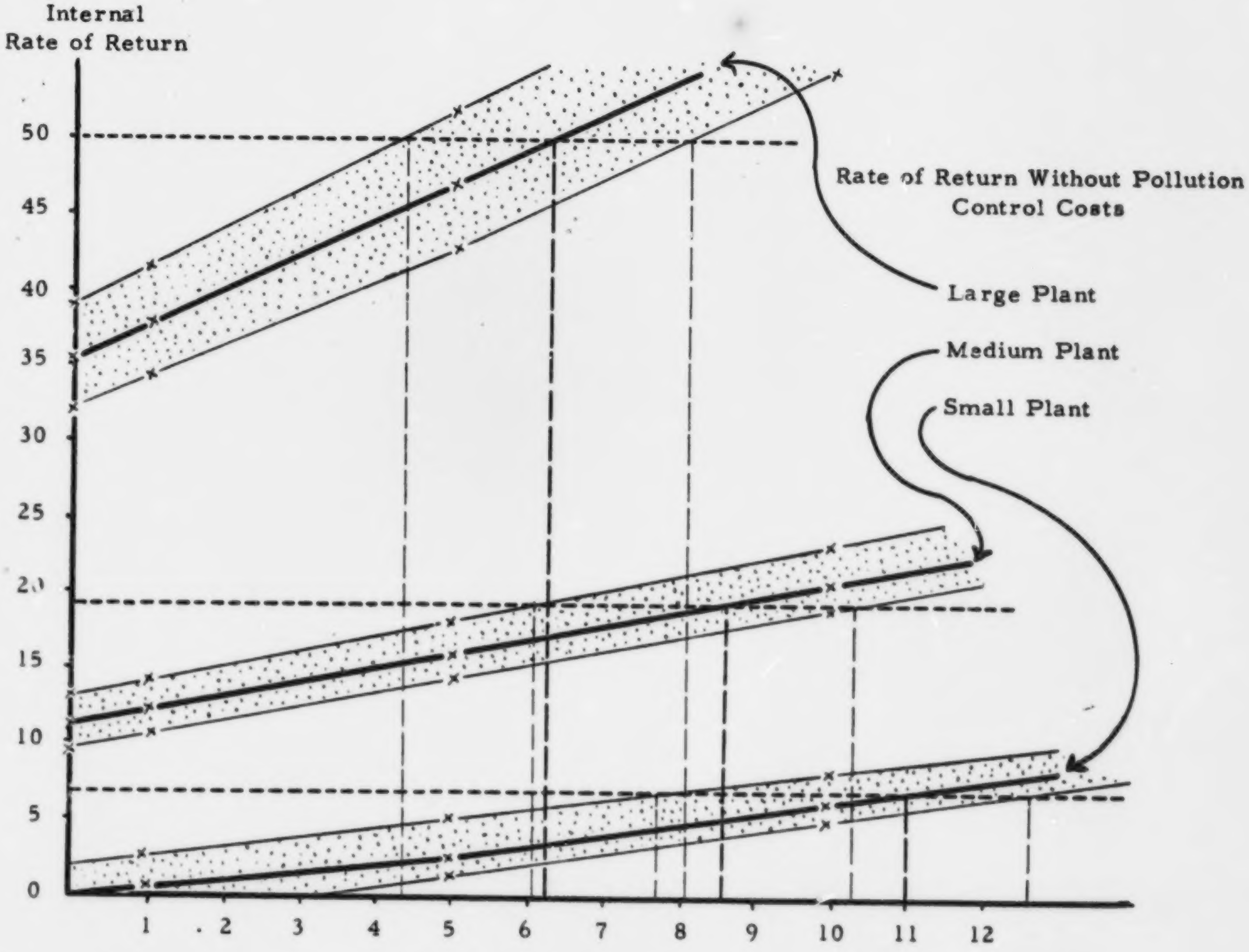


Exhibit 2. Price Increases Required by Various Sized Pea and Corn Canning Plants to Offset the Estimated Cost of Pollution Abatement Facilities (Plus or minus 30 percent)

Assuming that 50 percent of the individual plants will use municipal facilities and that they will not be subsidized by local communities, but must pay the incremental cost for use of a small city system, this will amount to the following:

Plant Grouping	Percent of Total Volume	Required Price Increase Low	Average	High
Large	80	1.6	2.5	3.1
Medium	15	2.4	3.1	3.9
Small	5	2.5	3.2	4.2
Weighted average increase required		1.8	2.6	3.3
Average plant and municipal treatment		3.3	4.2	5.5

According to information received from CEQ, about 58 percent of the abatement technology is installed and is currently being paid for under present operating conditions and present price levels. Thus the overall price increase necessary to recover costs in pollution abatement facilities would amount to 1.8 percent with a range from 1.4 to 2.3 percent.

VI. OVERALL IMPACT ON THE INDUSTRY

Because of the unique structure and competitiveness of the fruit and vegetable processing industry, pollution abatement facilities will have very serious consequences on the industry itself. Unless some lower cost pollution abatement alternative such as municipal treatment can be found the smaller third -- and to some extent the middle third -- of the plants will be seriously impacted. They most likely will not be able to recover the cost of installing and operating the abatement facilities and will most likely be forced to shut down. Little impact, however, will be felt by the ultimate consumer of the fruit and vegetable products.

A. Price Increase

With an overall expected price increase of 1.4 to 2.3 percent, the less efficient medium sized plants and especially the small plants can not be expected to recover the costs expended for pollution abatement facilities unless they can develop lower cost alternatives. In addition, many of the small and medium size plants are currently operating in a marginal position and would not be able to cover the abatement costs from their current profit level. Larger plants appear to be in a stronger position. If the small and medium size firms would attempt to raise prices to the level where they could recover the costs of their pollution abatement facilities, they would be quickly undersold by the larger firm.

It should be remembered that the estimated level of capacity at which the industry is operating is approximately 75 percent or less. At that rate the large firms could quickly step up production to fill the void of the small and medium size plants that may be forced out of business.

Little impact of pollution abatement will be felt by the ultimate consumer. Because of the relative inelastic demand for fruits and vegetables, the resultant decrease in per capita consumption of fruits and vegetables is estimated at 0.5 to 1.0 percent or approximately 1 to 2 pounds per capita. This would be less than the total annual increase in consumption resulting from population expansion and projected increases in per capita consumption.

B. Impact on Profitability and Financial Position of the Industry

Profitability in the fruit and vegetable industry is generally considered low. With pollution abatement standards imposed on the industry profit margins will be further reduced because of the structure and competitive nature of the industry. While average incremental costs for pollution abatement are expected to be passed through to consumers, the smaller firms are expected to have much higher than average per unit costs of abatement.

Capital requirements for the fruit and vegetable industry are obtained primarily from standard commercial sources outside the industry. A firm must compete in the capital markets along with all other firms seeking capital. The primary requirement then is a demonstrated record of good performance and the individual firm's ability to project adequate net returns following an expanded investment program. Consequently, capital availability is directly related to profitability -- and the smaller, inefficient firms have difficulty raising the needed capital to stay in business.

It is anticipated that additional capital requirements for financing pollution abatement measures will also principally be sought from standard commercial sources. When smaller firms are not able to present evidence that they can increase prices to offset the abatement costs -- and when abatement financing requirements amount to 50 to 100 percent of their total capital investment -- small firms will simply not be able to compete in commercial financial markets for capital necessary to install pollution abatement facilities. The larger-more efficient plants, in a good position to recover a portion of their costs, will be in a much stronger position.

C. Industry Dislocations

The fruit and vegetable processing industry is comprised of many firms differing in process (canning, freezing), products processed (multi-single), size (rate per hour), length of season (long/short), capacity and utilization of capacity, level of technology (new/old) and other factors.

It is therefore extremely difficult to make broad generalizations for the industry. It would appear, however, from our analysis that the major variable is size of operation. From our analysis then, we can conclude that the small firm producing 5 percent of the total product and the medium size firm producing 15 percent of the product are faced with very serious difficulties should they be forced to add pollution abatement facilities to their operations. Other studies and our informal survey of key states indicates that roughly half of the plants will be able to utilize municipal facilities or possibly other low cost operations. This means that roughly one-third of the plants in the industry will be forced to shut down unless other low cost pollution abatement facilities can be developed. With approximately 1,200 plants in the canning and freezing industry this could mean the shut down of 400 plants.

Location - Many of the marginal processing plants likely to be affected adversely by pollution abatement controls are located in areas or regions of the country that are already relatively economically depressed. Processor, grower and associated businesses are generally a major component of local economic development in these areas; and, consequently, any appreciable impact on these businesses will also impact the entire local economy via indirect multiplier effects on area incomes, employment, sales, level of trade, etc. Such effects are likely to be far more consequential in aggregate than the direct impacts of pollution abatement on the industry itself. Specific locational effects are discussed in Part III.

D. Employment

Since many fruit and vegetable processing plants are located in relatively small urban centers and rural areas, the potential impact of dislocations may be born disproportionately by areas which already lag the nation in economic health. Approximately 90 percent of the employees of processing plants are relatively unskilled and only part-time employed. This large segment of the total labor force required is not generally mobil and would have difficulty relocating. The remaining 10 percent of management and higher-skilled production worker labor force would be more mobil, but many would not likely be needed or absorbed for some time by the remaining industry given current widespread underutilization of capacity in the industry.

The potential for individuals to shift from small plants that might be dislocated to larger plants is of limited significance. For example, the sweet potato canning plants analysed in this report had a production worker labor force of 55 people for the small (80 cases per hour), 90 for the medium (280 cases per hour), and 190 for the large (760 cases per hour). If 400 small and medium size plants were forced to shut down this would directly result in the loss of jobs by 28,000 employees.

E. Raw Product Suppliers

The impact of economic dislocations in the canning and freezing industries will be felt quite strongly by raw product producers. The industry, as pointed out earlier, is supply oriented. The locational pattern of processing plants is directly linked to the raw product production pattern. A majority of the processing firms procure their raw product supplies from an area within 50 miles of the plant. Again, the opportunity to produce for larger processors is given little significance.

F. Supplies and Customer Impacts

Supplier Impacts - Suppliers of inputs will be affected mostly on an area-by-area basis due to expected plant dislocations rather than in aggregate. This follows in that industry-wide supply requirements, while perhaps depressed in the short-run, will soon return to and exceed previous levels. On the other hand, area-by-area dislocations will probably be long term.

Customer Impacts - Wholesale and retail customers can expect higher prices for products with consequent higher retail prices to final consumers. Given probable "pass-through" of prices, the net affect on the customer industries if expected to be relatively minor. An overall expected price increase of 1.4 to 2.3 percent and the generally inelastic nature of demands for fruits and vegetables, plus normal growth in demand, suggest that total volume of demand will not decrease drastically given the expected increase in price. A possible decrease of 1 to 2 pounds per capita can be expected.

G. International Trade

Imports of Processed Fruits and Vegetables - The impact of increased imports of processed fruits and vegetables associated with anticipated increased costs of domestic processed products, is generally expected to be limited.

Exports are significant for selected products and higher processing costs will affect the U. S. competitive position in foreign markets. If sales are reduced, a deterioration of U. S. balance of payments will result. The extent of this deterioration will depend on how effectively the particular segment of the industry can control pollution at a minimum cost.

Balance of Payments - The overall tendency of pollution abatement controls in the fruit and vegetable processing industry, because of relatively higher domestic prices, will be toward an adverse balance of payments: export sales volume will tend to be less, while import purchases will tend to be higher. However, loss in sales volume will be partially off-set in terms of balance of payments via higher prices. The net impact will not likely be substantial, however.

VII. SPECIFIC ECONOMIC DISLOCATIONS

A. Regional Impacts

A major effort was placed on determining expected differential region/area impacts of pollution abatement costs on the canning and freezing industries. The method used was to identify all known plants by location and other key attributes, particularly size. Cross-tabulation analyses were then completed with emphasis on size distribution patterns of all processing plants among regions, states, and counties within the continental United States.

A total of 1188 canners, freezers and combination canner/freezers were included in the analysis. A summary of results are illustrated in Exhibit 3, which is presented in four parts as follows:

Part A: Number, Type and Size Distributions of All Canning and Freezing Plants by Census Region, 1970.

Basic numbers of various type plants are presented by census region. For the U.S. as a whole, about 70 percent of all plants are canners, and approximately 15 percent are freezers and, also, combination canner/freezers.

A key distribution, however, is the size distribution of all plants among regions. Each type of plant was coded into three groupings: 'small,' 'medium,' and 'large,' so that approximately one-third would be in each for the U.S. as a whole. Hence, of primary interest is to identify those regions/areas which deviate from the overall average. Furthermore, on the premise that small plants will be most adversely impacted, concern is focused on region/areas containing above average levels of 'small' plants.

Part B: Percentages of Small Plants in Total and in EDA Qualified Counties Only

This bar graph of regional percentages of 'small' plants relative to total plants illustrates a wide variability in percentage levels among regions. Also, four of the nine census regions are shown to be above the U.S. average percentage: (1) New England, (2) South Atlantic, (3) Middle Atlantic, and (4) Mountain. These regions are expected to be more severely impacted relative to the remainder due to the higher concentrations of small plants. (See Part C for location of regions.)

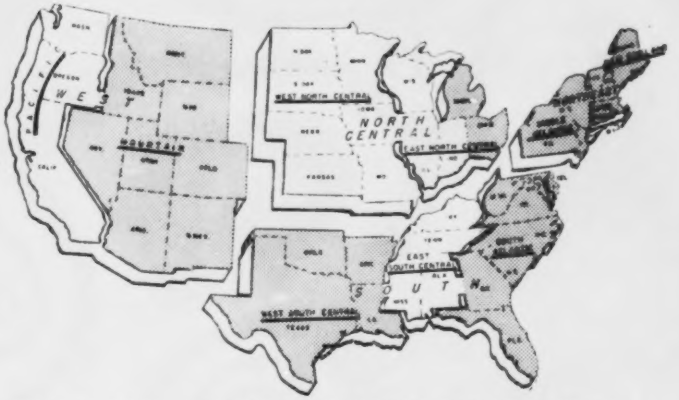
PART A

Number, Type and Size Distributions of All Canning and Freezing Plants, by Census Region, 1970

Census Region	All Plants Totals No.	 Pct.	 Number by Type Plant Canner	 Freezer	 Both	 Percent by Size Small	 Medium	 Large
New England	32	3	19	9	4	53	34	9
Middle Atlantic	179	15	121	28	30	42	30	27
E. North Central	278	23	221	17	40	35	28	37
W. North Central	45	4	41	2	2	24	24	51
S. Atlantic	205	17	152	25	28	52	30	18
E. South Central	25	2	18	6	1	20	32	48
W. South Central	81	7	70	4	7	32	31	37
Mountain	49	4	33	8	8	39	27	33
Pacific	294	25	166	77	51	28	[illegible]	44
Total U.S.	1188	100	841	176	171	36	29	34

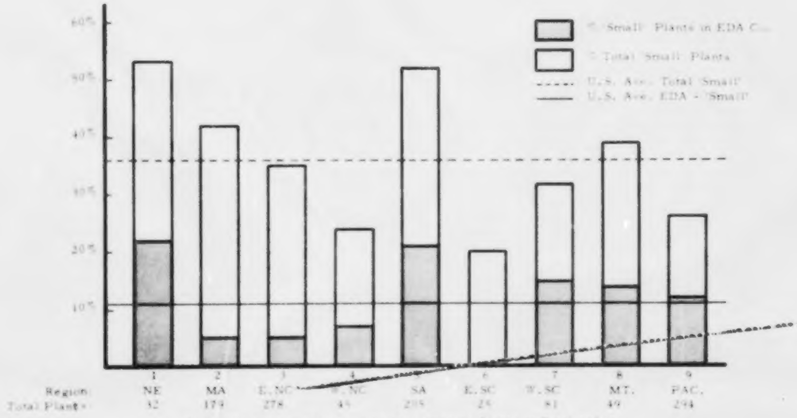
Source: Agri Division, Dunlap and Associates, Inc.

PART C


PACIFIC
WEST
MOUNTAIN
NORTH CENTRAL
WEST NORTH CENTRAL
EAST NORTH CENTRAL
SOUTH
EAST SOUTH CENTRAL
WEST SOUTH CENTRAL
SOUTH ATLANTIC
MIDDLE ATLANTIC
NEW ENGLAND

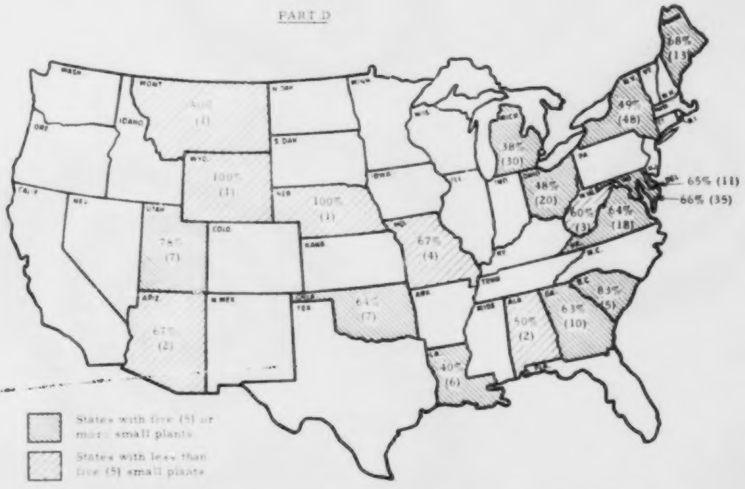
Major Regions with Above U.S. Average Percentage of 'Small' Canning and Freezing Plants, (Plus Other States with More than 5 'Small' Plants and Above Average Percentage of Small Plants), 1970

PART B



Percentages of 'Small' Canning and Freezing Plants in Total and in EDA Qualified Counties Only, by U.S. Census Region, 1970

PART D


68% (13)
49% (48)
38% (30)
48% (20)
60% (3)
64% (18)
65% (11)
66% (35)
100% (1)
100% (1)
78% (7)
67% (4)
64% (7)
67% (2)
40% (6)
50% (2)
63% (10)
83% (5)
States with five (5) or more small plants
States with less than five (5) small plants

States with Above U.S. Average Percentage of 'Small' Canning and Freezing Plants, 1970

EXHIBIT 3

A secondary measurement depicted in this graph in the percentage of 'small' plants which are also located in Economic Development Administration (EDA) qualified counties. Overall community impacts are expected to be especially critical should plants in these areas be shut down.

Part C. Major Regions with Above U.S. Average Percentage of 'Small'' Plants

The four census regions with higher than average concentrations of small plants, as described in Part B, are shaded on the U.S. map shown. In general, the East, South and Rocky Mountain areas of the country are expected to be most seriously affected with the adoption of pollution controls.

Part D. States with Above U.S. Average Percentage of 'Small' Canning and Freezing Plants

Cross-tabulation analyses were also completed on location bases smaller than census regions, e.g., states, economic regions and subregions and counties. This part of the exhibit shows states having percentages of small plants above average.

On this less-aggregate basis, a more precise identification of probable 'problem areas' is obtained.

B. Local Impacts

The above overview of small plant distributions by region and state represents relative differences among these areas. However, all regions do have 'small' plants -- ranging from 20 to 53% as shown in Part A above. Thus, no region will be completely unaffected. (Also marginal 'medium' plants are expected to be impacted adversely. Note that 'medium' plants are rather uniformly distributed by region, however.)

A separate analysis on a county-by-county basis was also made to ascertain probable absolute impacts on local areas. A summary of all counties within the U.S. which have two or more small plants (regardless of the relative criteria above) is as shown in Exhibit 4.

While many counties with only single 'small' plants are not shown (about 60 percent of all small plants are in the counties depicted), those shown are representative of local areas which will be impacted. Special note

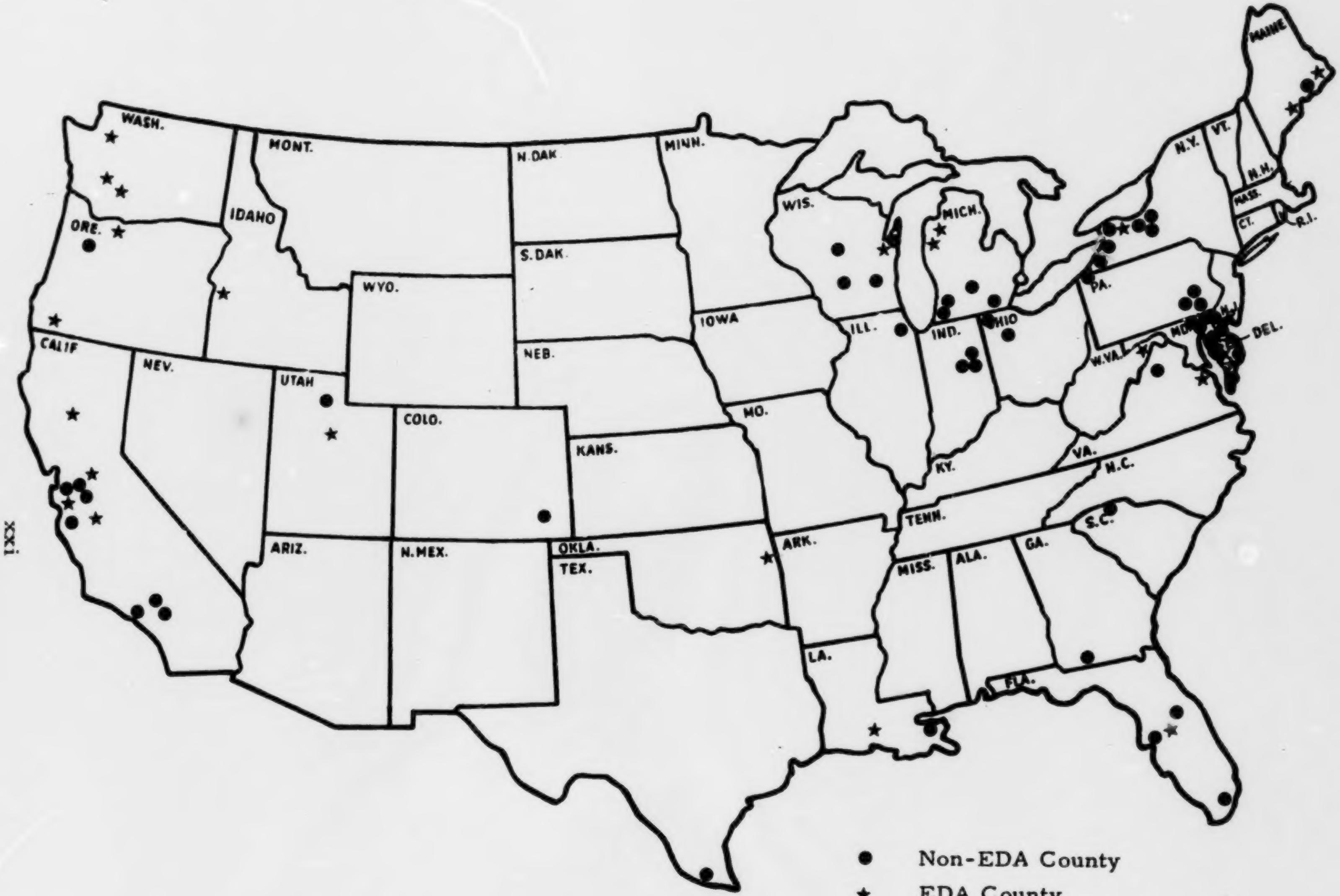

WASH.
MONT.
N.DAK.
MINN.
WIS.
MICH.
N.Y.
VT.
MAINE
N.H.
MASS.
CT.
R.I.
ORE.
IDAHO
S.DAK.
WYO.
IOWA
ILL.
IND.
OHIO
PA.
N.J.
DEL.
MD.
CALIF
NEV.
UTAH
NEB.
COLO.
KANS.
MO.
W.VA.
VA.
KY.
N.C.
TENN.
S.C.
ARIZ.
N.MEX.
OKLA.
TEX.
ARK.
MISS.
ALA.
GA.
LA.
FLA.
● Non-EDA County
★ EDA County

Exhibit I-4. Counties with Two or More 'Small' Canning or Freezing Plants (Approximate Actual County Locations), 1970.

is made of those areas, particularly in the West and North Central states, which will be impacted even though the affected plants are relatively few in comparison to total plants in their respective areas. Note again the distinction of EDA vs. Non-EDA counties. More adverse associated economic dislocations are projected for 'small' plants in EDA counties which are likely to be shutdown.

Further local area analyses are presented in Part III of this report. Also, individual plant data by county are provided in the Part IV Statistical Supplement.

ECONOMIC IMPACT OF ENVIRONMENTAL CONTROLS ON THE FRUIT AND VEGETABLE PROCESSING INDUSTRIES

I. INTRODUCTION

In an effort to reverse the progressive deterioration of the environment, new environmental standards are being established at federal, state and local levels. Currently available pollution abatement technology is being improved with intensified research and development efforts resulting in new and more advanced environmental control equipment, processes and systems. The impact of such intensification of environmental management is being seen in terms of reduction of environmental degradation associated with the disposal of industrial wastes throughout the nation.

However, implementation of environmental controls normally results in added costs to affected industries and may result in economic adjustments within these industries. The nature and extent of such adjustments must be considered in developing an effective and equitable program of environmental controls. The evaluation of the economic impact will require an answer to a series of important questions:

- What is likely to happen in terms of profitability, growth and capital availability in the industry?
- What are the price effects on its products?
- What are the balance of payments effects due to domestic and international shifts in supply and demand for its products?
- What plants or firms are likely to have to shut down or curtail production?
- What are the industry-wide or regional dislocation impacts?
- What are the effects on the industry's suppliers and consumers?
- What is the anticipated impact on employment? Are such effects likely to be concentrated in specific regions of the country?

These and other important economic questions must be resolved before an effective system and schedule of environmental controls can be finally established for specified types of industries.

In an effort to begin to provide answers required, the Council on Environmental Quality is carrying out a series of microeconomic studies aimed at evaluating the economic impact of environmental controls on major industries. One such industry is the fruit and vegetable canning and freezing industry.

The need for such information is urgent and the time available for such research is limited. As a consequence, it has been necessary to depend on secondary sources of published data and to review and adapt the results of existing studies related to the fruit and vegetable canning and freezing industries insofar as such studies were applicable to the questions posed by this project.

A. General Approach

To determine the economic impact of pollution abatement controls on the fruit and vegetable canning and freezing industries in aggregate, it is first necessary to assess expected differential impacts among firms within these industries. The general approach pursued is, therefore, to evaluate microeconomic relationships among representative firms within the fruit and vegetable processing industries as a first step; and, second, to project macroeconomic impacts based upon the expected impacts at the microeconomic level.

In order both to select "representative" processing plant operations within the fruit and vegetable processing industries and to evaluate probable industry-wide changes given expected changes for representative firms, it is essential to become thoroughly familiar with overall industry characteristics. The major purpose in Part II of this report is, therefore, to develop requisite background characteristics of the industry.

Following development of background information, emphasis is then directed toward development of methodology for microeconomic analysis and application of impact analysis as reported in Part III.

B. Acknowledgments

The authors would like to recognize the valuable assistance received from those who generously contributed of their time, ideas and made available information relevant to the project. An attempt will not be made to list the names of all individuals contributed but major organizations and their area of contribution, along with the principal authors of this report, are listed below.

Special thanks are due the National Canners Association of Washington, D.C. and the Laboratory at Berkeley, California, who contributed detailed industry statistics and documented data consolidated from a sample of canning firms.

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Sunkist Citrus Growers of California contributed detailed industry statistics on the citrus industry of California and Arizona.

Mr. Hoff Stauffer of the Environmental Protection Agency served as Contract Representative and provided valuable coordination of informational materials and project details from the Council on Environmental Quality and EPA.

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II. METHODOLOGY

To ascertain the economic impact of pollution abatement costs on the fruit and vegetable canning and freezing industries, it is critical to assess probable differential impacts among representative firms within the industry. All firms are not expected to be affected equally in terms of per unit costs of abatement. Economies of scale will exist in controlling pollutants associated with processing.

A microeconomic evaluation of plants within the fruit and vegetable processing industry is needed to assess probable impacts within the industry. From this base of information, overall impacts on the industry can be meaningfully projected.

A. Analytical Approach

The analytical approach developed for this study involves economic engineering-synthesis of cost and return data for individual representative processing plants within the fruit and vegetable industry. Economic performance of these representative plants are analyzed for 20 years of simulated operation. Two situations of primary concern are: (1) simulation of plant operations without internalized pollution abatement controls, and (2) simulation of operations with such controls.

The main results of the above analyses are comparative data, with and without pollution abatement controls assumed, for various representative plants within the industry. Probable impacts on individual processing plants can be assessed.

In order to generalize the individual plant impacts, a broad range of "representative plant operations" is proposed. A key variable or factor in this regard is size of operation, e.g., small, medium and large, for various fruit and vegetable processing plants. Patterns of impact among different size categories across different products are important in terms of generalizing from individual plant data.

Other variables, in addition to size of plant, must be explored to ascertain probable impacts of pollution abatement within the industry. Variables such as level of technology (high/low), level of capacity utilization (high/low), number of products (multi/single), length of processing season (long/short), and others are critical factors within the fruit and vegetable processing industry. Profitability of individual plants and their financial capacity to withstand costs of pollution abatement will vary among the variables cited.

In summary, the analytical approach is a microeconomic evaluation of a broad range of "representative" plants within the industry. Requisite data are to be generated from secondary sources and economic/engineering synthesis as needed. Economic performance, with and without pollution abatement costs, is to be assessed via a 20 year cash-flow simulation of representative plant operations.

B. Economic Cash Flows and Internal Rate of Return Analysis

A specific technique for evaluating the economic performance of individual plant operations under simulated conditions is being utilized in this study: discounted economic cash-flow and internal rate of return analysis. This technique is now often used to assess the economic viability of proposed facility investment-operation alternatives. A modified application of this technique is applicable for this study to assess relative impacts of proposed additional investment in pollution abatement facilities.

The modification required in the analysis is principally an assumption regarding representative investment values for existing (previously operated) plants. As is discussed below, plants are costed at current price levels initially and analyses made regarding differential rates of return among plants which have been "costed" at current levels. Further analyses are then to be completed to assess differences among plants which were constructed previously.

Relative relationships or impacts should be comparable in either of the above cases, so the modified application of the technique is believed appropriate. Another way of expressing this modified application is that "replacement values" for investment are used in place of actual (prior) investment values.

Economic cash flow and internal rate of return analysis is now described briefly as background for following applications. It is basically a method used to measure the economic viability of proposed investment-operation alternatives. Economic cash flows which simulate expected conditions over time are constructed, usually for alternative possibilities of construction and/or operation. These cash flows are utilized to calculate associated internal rates of return. The internal rate of return is an estimate of the true economic earning power that a proposed investment is capable of generating. (The internal rate of return is the discount rate, applied to net returns and investments, which would yield a benefit/cost ratio equal to one.)

The first step is to construct an economic cash flow over the planning horizon (in this case, an annual cash flow over a 20 year period). This is accomplished by estimating (1) annual outlay for investment facilities and operating capital and (2) annual net revenue (total revenue less raw material and operating expenses). All investment items are entered during the year of expected incurrence. Net revenues are calculated for each year of operation at the actual expected rate. Certain key items which are normally included in a firm's financial cash flow accounting are excluded.

Depreciation is excluded as an annual expense item since replacement of components is accounted for as an additional capital outlay in the year in which they are needed. Interest is omitted as an operating expense so that the true economic return which the investment is capable of generating may be calculated apart from the "market" cost of money. Income taxes are excluded since they cannot be calculated without knowledge of actual profit rates, etc.

No escalation of investment outlay is used for replacement facilities. Conversely, the expected product and raw materials price are held constant over the life of the venture. The underlying assumption is that any increase in the prices of facilities will be offset by proportional increases in product prices.

The economic cash flow as described here should not be confused with a financial or business cash flow. The actual profit rate in any business will be different than its economic rate of return, because the financial flow includes items such as interest, debt retirement, depreciation and taxes, which are excluded from the economic cash flow. From the economic cash flow it is possible to compute the profit rate on equity capital in the enterprise, but only by accident would the profit rate be equal to the internal rate of return.

Several tests of economic feasibility can be used. They include among others: payback period, proceeds per dollar of outlay, and average proceeds per dollar of outlay. In these methods all proceeds received during the payback are treated as equals and all proceeds received after payback are ignored. Other methods, such as the feasibility ratio and internal rate of return, seek to account for time by converting the future outlays and returns to an equivalent present value on the proposition that a dollar in hand today is more valuable than a dollar to be received a year from now. We believe that the "internal rate of return" gives potential investors and financial analysts a better evaluation index for investment-operation ventures, at this point in time, than any other single measure of economic viability available.

The second step toward measurement of economic feasibility of selected alternatives, is to compute the "internal rate of return" for each economic cash flow considered. The internal rate of return is the discount rate which makes the "present value" of money invested in a given project over a period of time equal the "present value" of money received as net revenue (gross revenue - expenses) over the length of the project. [1/] In other words, it is the compound rate of interest at which the present value of the project investment would have to be invested at the current time to yield a return equal to that earned by the project investment over its life.

[1/] Mathematically, the expression is:

$$\left[N_1 + N_2 \frac{1}{1+x} + N_3 \frac{1}{(1+x)^2} + N_4 \frac{1}{(1+x)^3} + \ldots + N_n \frac{1}{(1+x)^{n-1}} \right] =$$

$$\left[I_1 + I_2 \frac{1}{1+x} + I_3 \frac{1}{(1+x)^2} + I_4 \frac{1}{(1+x)^3} + \ldots + I_n \frac{1}{(1+x)^{n-1}} \right]$$

Where

I = Investment in facilities in any given year of the cash flow.

N = Net revenue (total revenue minus annual operating expenses except income taxes, interest, and depreciation) in each year of the cash flow generated by investment I.

x = Computed internal rate of return.

n = Final year of cash flow.

$\frac{1}{(1+x)^n}$ = Computed "present value factor" for each given year of the cash flow as indicated in cash flow output tables.

In the past it has been a hand procedure of trial and error to find the "internal rate of return" for any given cash flow. However, with the aid of a modern digital computer a large number of cash flows reflecting various conditions can be analyzed quickly and economically.

The goal of any investment is to obtain a high rate of return. If a sufficiently high rate of return cannot be realized, the project is not feasible. Obviously, the criteria as to what is a "sufficiently high rate of return" depends on the investor and conditions in which he operates. Normally the rate of return expected by an investor for given venture is at least equal to the earning power of this capital for alternative uses. If the opportunity cost of the investor's capital is 20 percent, a venture must demonstrate at least this rate of return in order to be economically viable to him.

C. Data Requirements and Assumptions

To implement the above analysis for various representative plants within the fruit and vegetable processing industry, the data requirements summarized in Exhibit II-1 were established.

A brief discussion of each of the data input items, including general assumptions, will facilitate general interpretation of the findings.

Investment Costs

Total investment costs are subdivided into four input components for purposes of this study. Each component is described below, and the sum of these four yields the annual total investment required in the cash-flow analysis. A representative listing of data input is shown in Exhibit II-2 to illustrate these items by year of study.

1. General Facilities. This component represents the overall annual investment required to construct and maintain an operable processing plant. General items included are site and site preparation; buildings, including office and warehouse space for storage; equipment, both processing line and handling; and other, such as pallets, trucks, etc. which are fixed resources required for operation.

This item alone will generally cover all investments, excluding waste treatment facilities which are to be internalized. This latter item is discussed below.

In cash flow analysis, provisions must be made for replacement of equipment and other facilities which are expected to "wear-out" during the projected period of study. In other words, each processing plant is to be maintained in operable condition throughout the 20-year study period. Salvage values, if any, should also be credited in the final year, however.

Because many processing plant operations are to be analyzed in this study, the following simplifying, but generally representative, assumptions are made concerning maintenance investments through time:

(1) Plant facilities, excluding equipment, are assumed to have a 20-year useable life; although such plants after 20 years would likely have little salvage value. Thus, no final-year salvage values are included.

TYPE OF DATA	RELATIONSHIP TO AGGREGATES SHOWN IN COMPUTER PROGRAM OUTPUT
	Investment ($1000)
Total Investment Costs	
1. General Facilities 2. Working Capital 3. Other, General	Facilities & Working
4. Waste Treatment Facilities	Waste Treatment
	Total
	Operating ($1000)
Total Revenue	
5. Revenue w/o Waste Treatment 6. Change in Revenue w/Waste Treatment	Total Revenue
Total Operating Costs	
7. Operating Cost w/o Waste Treatment 8. Other, General 9. Incremental Cost w/Waste Treatment	Operating Expenses (-)
	Net Revenue

Exhibit II -1. Summary of Types of Data Required for Economic Cash Flow and Internal Rate of Return Analysis.

Exhibit II-2. Sample Data Input

```
           INTERNAL RATE OF RETURN ANALYSIS OF POLLUTION CONTROL MEASURES
                              DATA INPUT DESCRIPTION
                              ----------------------
     CANNED CORN & PEAS--LARGE PLANT--PREVALENT TECHN--75% UTIL--WITH TREATMENT
----------------------------------------------------------------------------------
----------------------------------------------------------------------------------
                     TOTAL INVESTMENT              TOTAL REVENUE   TOTAL OPERATING COST
           ------------------------------------  --------------  ----------------------
                                          WASTE   REVENUE CHANGE  OP COST          CHANGE
YEAR       GENERAL WORKING  OTHER  TREATMNT W/O WST REV W/  W/O WST  OTHER  COST W/
 NO YEAR   FACIL   CAPITAL  GENERAL  FACIL   TREAT  WST TR   TREAT   GENERAL WST TR
 -- ----   ------- -------  -------  ------- ------- -------  -------- ------  ------
  1 1971    3550    2036     -604     440     5798             4076    413      20
  2 1972                                      5798             4076    413      20
  3 1973                                      5798             4076    413      20
  4 1974                                      5798             4076    413      20
  5 1975     831              -141            5798             4076    413      20
  6 1976                                      5798             4076    413      20
  7 1977                                      5798             4076    413      20
  8 1978                                      5798             4076    413      20
  9 1979                                      5798             4076    413      20
 10 1980     831              -141            5798             4076    413      20
 11 1981                                      5798             4076    413      20
 12 1982                                      5798             4076    413      20
 13 1983                                      5798             4076    413      20
 14 1984                                      5798             4076    413      20
 15 1985     831              -141            5798             4076    413      20
 16 1986                                      5798             4076    413      20
 17 1987                                      5798             4076    413      20
 18 1988                                      5798             4076    413      20
 19 1989                                      5798             4076    413      20
 20 1990           -2036                      5798             4076    413      20
```

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(2) Plant equipment is assumed to have an aggregate 10-year average expected life. Complete replacement of all equipment would therefore be required during the tenth year. However, such investments are typically more evenly distributed through time. To better represent typical conditions, three equal investments of one-third the initial equipment costs are entered in the fifth, tenth and fifteenth years of analysis. No salvage values are expected, on average, in the final year.

The terms-of-reference and time-frame for this study require almost exclusive use of secondary data in this analysis. Hence, investment requirements are typically obtained from previous studies of plants within the industry and/or engineering-synthesis of such data.

A problem arises concerning secondary data from various previous time periods. In order to standardize or "normalize" the data for cross-comparison of results, all data used are adjusted to 1970-71 conditions. General index inflators, as described below, are used to adjust data as required.

2. Working Capital. A second component treated as investment in cash-flow analysis is operating or working capital. Working capital is required for products in inventory and accounts receivable.

For most processing plants, production occurs primarily during a 2-4 month operating season, but sales are generally spread over the entire year. On this basis, the average amount of capital tied-up for the year would approximate one-third of the total annual operating costs.

This allowance would generally also cover accounts receivable, and thus, the study assumption adopted is as follows: Annual working capital requirements are estimated as one-third of the total annual operating costs.

Working capital can be viewed as a revolving or one-time account which is required beginning in the first year and possibly growing until full operating levels are reached. In this study, it is further assumed that plants are fully operable in the first year and that a constant output per year will be achieved. Thus, the required working capital is entered in-full in year one.

3. Other General. This investment category is available simply to expedite input of data for various alternative analyses. Only incremental changes from a base-line case need be input.

For example, various levels of technology exist within plants in the processing industry, e.g., current, prevalent, and old. Taking one level as base-data, the alternatives can be more readily considered by utilizing requisite change-data in conjunction with prepared base-data.

These first three investment components are sub-totaled by the computer program and displayed annually under the column: Investment-Facilities & Working. This value is shown in sample output in Exhibit II - 3.

4. Waste Treatment Facilities. The final investment component of input data is the estimated total investment cost for waste treatment facilities for the particular plant under consideration.

Estimated waste treatment facilities costs are derived from the relationships, shown in Exhibit II-8, provided by the Council for Environmental Quality (CEQ).

Average daily flows of waste water, as required, are based on mid-point estimates of waste flows per standard unit of output (e.g. case) as published, by product, in The Cost of Clean Water. [1] The average daily output of each for the length of season assumed, is calculated. This output is then multiplied by the indicated mid-point waste flow to establish the average daily waste treatment requirement level. Finally, this latter flow is used in the relationship shown in Exhibit II-8 to derive estimated waste treatment costs for each plant.

Operating Revenues and Costs

Two types of data are required in cash flow analysis to represent operation of an enterprise: (1) Total Revenues by time period, and (2) Total Operating Costs by time period. The difference of these values by time period yields estimate of net revenue, i.e., a cash-flow of net revenues. The net revenue flow, in conjunction with the investment cost flow, is really all that is essential to determine the desired internal rate of return on investment. However, it is customary and generally preferred to display the above two types of data. In this study both types are shown in the computer program output as represented in Exhibit II -3., i.e., Total Revenue and Operating Expense. A Net Revenue column is also displayed, and it is calculated internally as Total Revenue less Operating Expense.

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[1] The Cost of Clean Water, Vol. III, Industrial Waste Profile No. 6, Canned and Frozen Fruits and Vegetables, FWPCA, U.S. Dept. of Interior, 1967.

Exhibit II-3. Sample Output

```
                          I N V E S T M E N T   F E A S I B I L I T Y   A N A L Y S I S

                               INTERNAL RATE OF RETURN ANALYSIS OF POLLUTION CONTROL MEASURES
                      CANNED CORN & PEAS--LARGE PLANT--PREVALENT TECHN--75% UTIL--WITH TREATMENT

                                       ANNUAL RETURN ON CAPITAL  28.65  PERCENT
                                                                 -------

                     INVESTMENT ( $ 1000 )                 OPERATING ( $ 1000 )                          PRESENT VALUE
     YEAR      ----------------------------------  ----------------------------------   PRESENT  ----------------------
 -----------    FACILITIES    WASTE                     TOTAL     OPERATING      NET       VALUE                    NET
  NO.  IDENT.   & WORKING   TREATMENT     TOTAL       REVENUE   EXPENSES **   REVENUE     FACTOR   INVESTMENT    REVENUE
 ----- ------  ----------  ----------  ----------  ----------  ----------  ----------  ----------  ----------  ----------
   1   1971       4584.        440.       5424.       5798.       4509.       1289.      1.0000       5424.       1289.
   2   1972          0.          0.          0.       5798.       4509.       1289.      0.7773          0.       1002.
   3   1973          0.          0.          0.       5798.       4509.       1289.      0.6042          0.        779.
   4   1974          0.          0.          0.       5798.       4509.       1289.      0.4696          0.        605.
   5   1975        690.          0.        690.       5798.       4509.       1289.      0.3651        252.        471.
   6   1976          0.          0.          0.       5798.       4509.       1289.      0.2838          0.        366.
   7   1977          0.          0.          0.       5798.       4509.       1289.      0.2206          0.        284.
   8   1978          0.          0.          0.       5798.       4509.       1289.      0.1715          0.        221.
   9   1979          0.          0.          0.       5798.       4509.       1289.      0.1333          0.        172.
  10   1980        690.          0.        690.       5798.       4509.       1289.      0.1036         71.        134.
  11   1981          0.          0.          0.       5798.       4509.       1289.      0.0805          0.        104.
  12   1982          0.          0.          0.       5798.       4509.       1289.      0.0626          0.         81.
  13   1983          0.          0.          0.       5798.       4509.       1289.      0.0487          0.         63.
  14   1984          0.          0.          0.       5798.       4509.       1289.      0.0378          0.         49.
  15   1985        690.          0.        690.       5798.       4509.       1289.      0.0294         20.         38.
  16   1986          0.          0.          0.       5798.       4509.       1289.      0.0228          0.         29.
  17   1987          0.          0.          0.       5798.       4509.       1289.      0.0178          0.         23.
  18   1988          0.          0.          0.       5798.       4509.       1289.      0.0138          0.         18.
  19   1989          0.          0.          0.       5798.       4509.       1289.      0.0107          0.         14.
  20   1990      -2038.          0.      -2038.       5798.       4509.       1289.      0.0083        -17.         11.
               ----------  ----------  ----------  ----------  ----------  ----------              ----------  ----------
        TOTAL     5016.        440.       5456.     115960.      90180.      25780.                   5751.       5751.


                 INTEREST                      BENEFIT/COST                    PRESENT VALUE IN  $ 1000
                 PER CENT                      ___RATIO___                  __REVENUE___OUTLAY____BALANCE_

                  -25.00                          -2.85                     1215541.   -426473.   1642014.
                  -10.00                         -21.98                       83820.     -3814.     87634.
                   -1.00                           5.44                       28410.      5225.     23185.
                    1.00                           4.17                       23493.      5631.     17862.
                   10.00                           2.00                       12071.      6036.      6035.
                   25.00                           1.10                        6371.      5800.       570.

  ------------

  **EXCLUDING DEPRECIATION, INTEREST, AND INCOME TAX                        AGRI RESEARCH     MANHATTAN, KANSAS
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5. Revenue Without Waste Treatment. Total operating revenue is comprised, in this study, of two components. The first part is estimated total revenue based on prices of product estimated to prevail prior to pollution abatement practices. These prices multiplied by projected annual output yield the desired total revenue estimates.

As discussed previously, no changes in price level are estimated under the assumption that changes both in product prices and production costs will be proportional. Hence, this analysis is based on prices estimated for the 1970-71 base period for each product analyzed. Actual price data are used in this study, versus inflator-adjustment of prices used in previous secondary-source studies. A further assumption, unless otherwise noted, is that estimated prices are f.o.b. plant prices.

6. Change in Revenue with Waste Treatment. A second total revenue component in this analysis involves any expected change in revenue following industry-wide adoption of pollution control procedures. In theory, additional costs of processing generally result in higher prices of products at retail and f.o.b. plant. Such a change in price, multiplied by total output per plant, can be input in this analysis simply as a change in total revenue. Should a negative change in revenue be required, this also can be input.

Input data items 5 and 6 are automatically summed by the program and shown as Total Revenue. This is illustrated in Exhibit II -3.

7. Operating Cost Without Waste Treatment. Total operating costs are input as three separate components, if needed. The first component generally applies to all processing plants before pollution control practices are considered.

Operating costs are calculated in various ways in secondary-source studies, but these include the following types of expense: labor, both full and part-time; raw product (fresh fruit and vegetables); other ingredients; containers; utilities; and all other materials and operating expenses. All variable operating costs are to be included.

As mentioned above, all plants are assumed to operate at specified levels and lengths of season beginning in year one. Operating cost data from previous studies are also adjusted (inflated) to 1970-71 conditions as required, but no further adjustment is estimated because of assumed proportional changes in costs and revenues. Hence, the operating cost derived is used annually throughout the time period of analysis.

8. Other, General. A second total operating cost component, Other, is included as input data simply to facilitate change of original base-line data. This input item need not be used.

Cases are expected where it is necessary to only partially modify original data. For example, a simple change in estimated cost of raw product per ton processed could be readily analyzed by inserting the appropriate change-data, with no other changes required.

9. Incremental Cost with Waste Treatment. A third and final component of total operating cost is designated for changes in operating cost following assumed installation and operation of waste treatment facilities within each plant studied. In all cases, initially, it is assumed that plants change from no internal treatment to complete internal treatment (secondary treatment level as prescribed) by each plant.

The waste treatment facilities are assumed to operate independent from the remainder of the plant operation. Hence, the additional operating costs are normally entered as an incremental cost item in the manner described. Waste treatment costs are provided by CEQ, as described above, and as summarized in Exhibit II-8 (Section D).

Input items 7, 8 and 9 are all total operating cost components which are summed automatically and displayed in the computer output, see Exhibit II-3, as Operating Expenses.

All requisite data for executing the program and calculating the internal rate of return are now provided. Another calculation is made, however. This is the derivation of Net Revenue, which is simply Total Revenue (as defined) minus Operating Expenses (as defined). Two cash-flow streams, as shown in Exhibit II -3, are of primary concern at this point: Total Investment and Net Revenue.

The program solves for a discount (interest) rate which, when applied as a present value factor to the Total Investment and Net Revenue streams, equalizes the present worth of the said two streams over the period of analysis (or the Benefit/Cost ratio equals one at this discount rate). The derived internal rate of return on investment is reported at the top of the output as shown in Exhibit II -3. Other output displayed are: (1) present value factors by year (for the internal rate derived), (2) estimated present values of the investment and net revenue streams (note equality of the total streams), (3) the benefit/cost ratios for selected interest rates, and (4) present values of total revenues, total outlays and their difference or balance. Some of these latter values are used to effectively evaluate probable impacts of changes in data, as will be discussed.

Other Assumptions

Various assumptions have been explained, by input item above, as applicable. However, additional assumptions have been made and/or are required for each specific application of the cash-flow analysis.

Most of these assumptions, regarding, for example, lengths of operating season, average capacity per hour, level of capacity utilization, etc. are problem dependent and are therefore discussed in the analysis section. One of the key additional general assumptions is, however, the method used to adjust or inflate data from various previous years to a common base.

The common base selected for pricing is a current 1970-71 period. This corresponds directly with the base prices established for waste treatment facilities provided by CEQ. Hence, waste treatment cost data can be used directly without further adjustments.

Given the base period above, alternative index series were evaluated for the purpose of adjusting cost data to current levels. A general index was selected: the implicit price deflator for Gross National Product (1958=100). This data series is shown in Exhibit II-4. Both investment and operating costs are adjusted (inflated) using this series. (Current prices are used to calculate total revenues, as explained above.)

Another assumption which should be re-emphasized concerns the simulated operation of processing plants first without and then with waste treatment facilities (capable of providing secondary-level treatment at the plant site.) Most existing processing plants fall somewhere along the scale from none-to-full secondary-level treatment. Hence, additional subjective analysis will be required to estimate probable industry-wide impacts.

Exhibit II-4. Implicit Price Deflator for Gross National Product (GNP) [1]

Index for Inflating Data

(Base 1958 = 100)

Year	GNP
1950	80.2
1955	90.9
1960	103.3
1965	110.9
1966	113.9
1967	117.6
1968	122.3
1969	128.1
1970	135.0
1971	141.3 [2]

---

[1] Source: Statistical Abstracts, U.S. Dept. of Commerce, Bur. of Census.

[2] Preliminary Est.

D. Critical Factors in the Industry

Many factors are relevant to the successful establishment and operation of fruit and vegetable processing plants. Some of the most critical relate to the required scale of operation (hourly rate) and length of operating season (total hours operation) as these factors affect per unit cost of finished product. Scale of operation must be large enough to enable the firm's costs to be competitive with other firms in the industry. Length of season operated must be adequate to provide an acceptable level of return on a firm's investment. Adequate supply of raw product throughout the operating season is a prime requisite for achieving the above economies.

In order to effectively present factors which are generally important in processing plant operation and their typical economic influence, a hypothetical (but realistic) case is discussed. Consider that a new vegetable processing plant is to be established and that feasibility analyses are being made. Some general requirements might be as follows:

(1) Multi-product processing (to accomplish longer season of operation).
(2) Yearly operation for at least 2,200 to 2,600 hours.
(3) Minimum yearly raw product requirement of 7,000 to 9,000 tons.
(4) Yearly production alternatives:

(a) Canning plant	600,000-1,000,000 cases
(b) Freezing plant	10-15 million pounds

A plant within the above size ranges would be expected to require some 4,000 to 6,000 acres of vegetable crops (with average yields) to provide a stable base of operation. This, of course, would vary with plant product mix, recovery levels, and yield per acre. Competition for raw products from fresh market demand, and competing processors, must be appraised to ascertain whether effective supply (in the magnitude of the above acreage figures) could be obtained and stabilized at a reasonable cost in the producing area of concern.

Technical Economic Relationships

A number of technical relationships exist in a processing plant operation which directly affect cost per unit of output. Three of the most important of these are briefly discussed below.

(1) Rate/Hour and Length Operating Season in Relation to Cost/Case

The general nature of processing plant economies relating to rate per hour and length of operating season in vegetable processing plants are illustrated in Exhibit II-5. These actual data relate to a given area and commodity (okra) but the nature of the cost structure and technical interrelationships within the processing industry are sufficiently standardized to permit a reasonable amount of generalization to other commodities and locations.

In this example, cost per case of okra can be effectively (and significantly) reduced both by increasing capacity in rate per hour and by extending length of operating season. This phenomenon is achieved through spreading of fixed labor, equipment and other costs over a larger volume of production. Although the degree of the relationship in Exhibit II-5 will vary with commodities and the cost structure of a given plant, the general principle illustrated may be expected to hold over a wide range of conditions. This helps explain why it is profitable for an established firm to incur greater variable costs in transporting raw products considerable distances to an established plant, thus achieving economies relating to fixed costs. An established plant at a considerable distance may be able to effectively bid products away from a smaller or new local plant by expanding its volume of operation either to a lower cost curve or a lower point on the same curve.

(2) Raw Product Requirement and Plant Size Related to Cost/Case

Cost relationships for snap beans as they pertain generally to processing in the South are presented in Exhibit II-6. The importance of operating a given capacity plant (rate per hour) as nearly as possible to optimum output to achieve maximum economies of operation is further illustrated. Note that operation at optimum capacity is of greater relative importance than size of plant in economy of operation, even though larger plants can ultimately achieve lower per unit costs. This points out the importance of an adequate and well planned supply of raw products in order for a plant both to maintain maximum capacity operation and to extend operations over an adequate length season.

(3) Less Than Capacity Operation and Length Operating Season Related to Cost/Case

In Exhibit II-7 from a 1962 study of sweet potato canning in North Carolina, the importance both of maintaining capacity operation and achieving a maximum length of operating season is again illustrated.

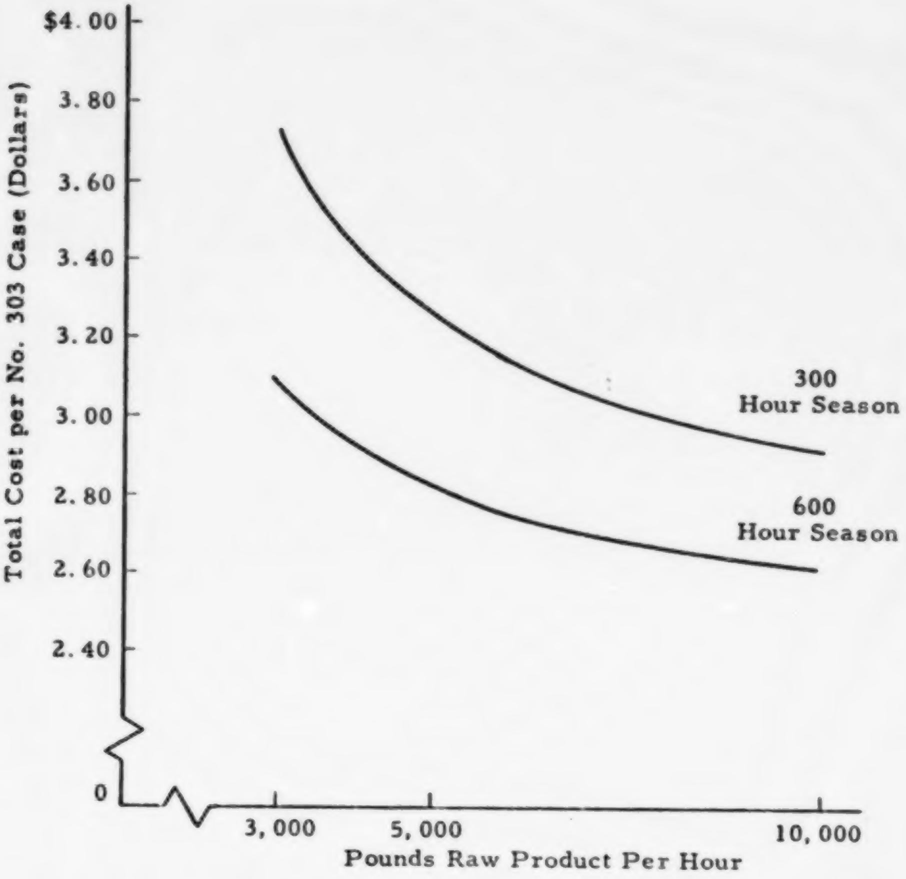
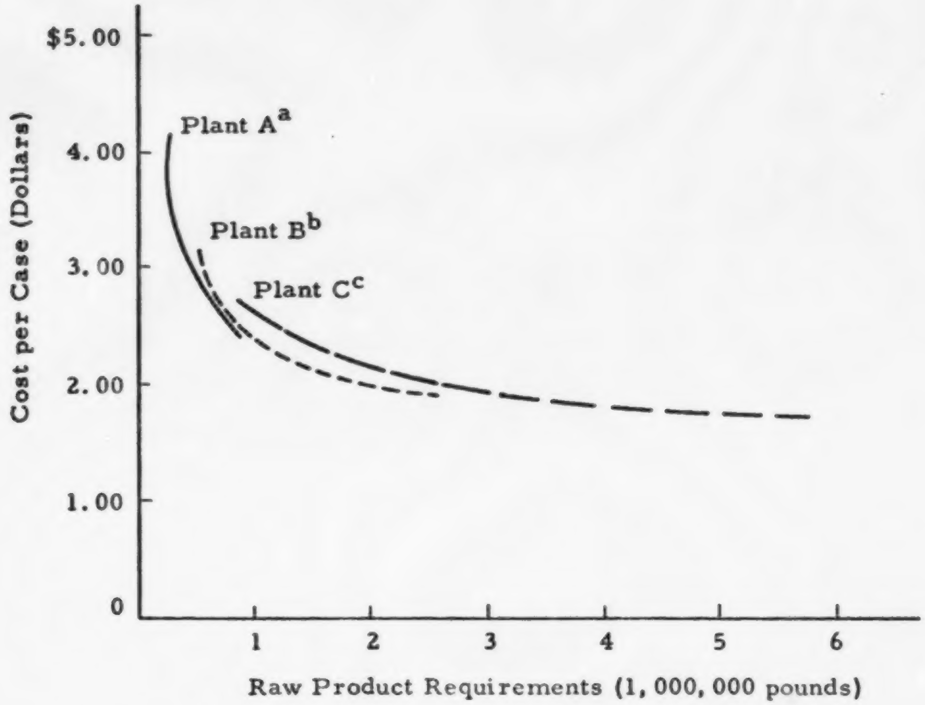


Exhibit II-5. The relationship between scale of plant (rate per hour), length of operating season and total cost per case (No. 303 Cans) of okra.

Source: Economic Efficiency and Profitability of Okra and Okra-Tomato Canning Plants, D.A.E. Research Report No. 339, Louisiana State University.



[a] 2,000 pounds per hour raw product input capacity
[b] 4,000 pounds per hour raw product input capacity
[c] 8,000 pounds per hour raw product input capacity

Exhibit II-6. Relationship between cost per case, raw product requirements, and plant size for specialized snap bean processing plants.

Source: Planning Agricultural Processing for the South, Snap Bean Canning, Agricultural Policy Institute, North Carolina State, Raleigh, North Carolina, August 1964.

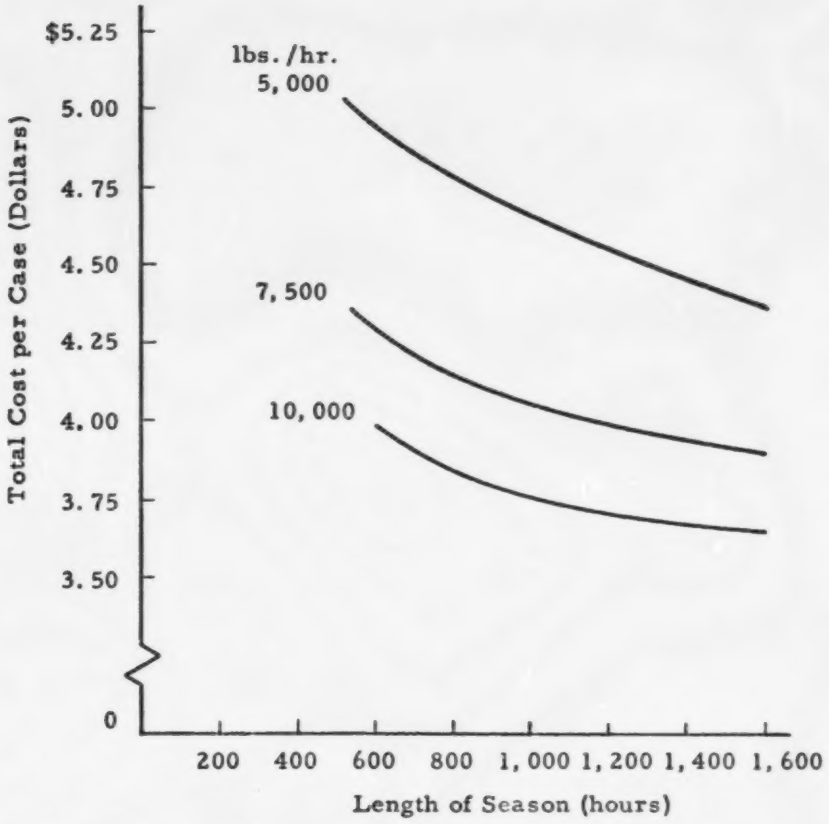


Exhibit II-7. Relationship between less-than-capacity operation, length of season, and total cost per case of canning sweet potatoes in a 10,000-pound per hour plant with 40 percent trim and peel loss.

Source: Planning Data for the Sweet Potato Industry, 2. Costs and Returns for a Model Canning Plant, A. E. Information Series No. 93, Department of Agricultural Economics, North Carolina State College, Raleigh, North Carolina, June 1962.

The graph clearly indicates the effect upon per unit cost of operation in a processing plant, at less than capacity levels, and over various lengths of season.

Maintenance of capacity output and maximum extension of operating season cannot be over-emphasized in regard to per unit economy of operation. Available supplies of raw products relate directly to satisfactory achievement of both these relationships.

The above relationships are based upon actual specific commodities and locations, but the principles involved are applicable generally. Any processing plant can expect to be confronted with cost curves of the same general nature of those illustrated above. The need for an abundant raw product supply in attaining competitive cost efficiencies should also be fully understood.

Other Factors

Many factors in addition to the technical relationships discussed above enter into the efficient and successful operation of a processing plant. A number of these factors are discussed.

Labor. A necessary ingredient for successful operation of a processing plant is a sufficient labor supply. Both full-time and seasonal (or part-time) labor are generally required.

A processing plant of the size outlined, with sufficient capacity to be competitive in the industry, is expected to require a minimum of 60-100 part-time and seasonal employees plus management personnel. Specific numbers in each category would depend upon whether a freezing or canning operation was initiated, length of operating season, and number and combination of crops to be processed.

Major labor shortages associated with the vegetable industry usually relate to production rather than processing. Numerous studies suggest no future for vegetable production based upon high labor activities such that any expansion in vegetable crop production must be based upon maximum mechanization. A supply of labor for large-scale vegetable production is often not locally available. Hence, while labor for a processing plant may be available, inadequate labor is typically not available for the supporting grower operations.

Management. The importance of management in the successful operation of a vegetable processing firm cannot be overemphasized. It is particularly critical for a new firm entering the industry. Experienced management must be bid away from existing firms which, at best, is an expensive procedure.

Plant Site and Related Facilities. Most important among considerations relating to selection of a plant site is assurance of an adequate water supply and waste disposal facilities. Large quantities of fresh water are required for canning and freezing of fruits and vegetables. An economically-sized plant such as outlined, can be expected to require minimum capacity for water and sewage of 25 to 35 thousand gallons per hour.

Processing plant sites need to be well situated. Development of lagoon-type waste disposal or other disposal facilities requires ample plant sites with suitable drainage characteristics.

Investment and Capital Requirements. Minimum capital requirements for an economically sized multiproduct vegetable processing plant can be expected to range widely. As a minimum, the sample plant might require between $600,000 and $800,000 for buildings and equipment. Annual charges might be expected to range between $100,000 and $300,000 for fixed costs and $1.5 million to $2.5 million for variable operating expenses. The above estimates assume an annual turnover of inventory and indicate a minimum total seasonal requirement for total operating capital ranging from $1.6 million to $2.8 million.

Transportation and Distribution. Important to the operation of a processing plant is the cost and availability of transportation facilities for movement of the finished product into consumption channels. Freight cost advantages over competing growing centers can be a significant factor in successful plant operation.

E. Water Pollution Abatement Costs

Water pollution abatement costs used in this study were provided by the CEQ. They were calculated with a computer based model developed to estimate both investment capital and operating capital required by the nation's industries to attain water pollution control standards. These "standards" are defined as equivalent of secondary treatments.

The configuration for a water plant to serve a fruit and vegetable processing plant is based on the following technology:

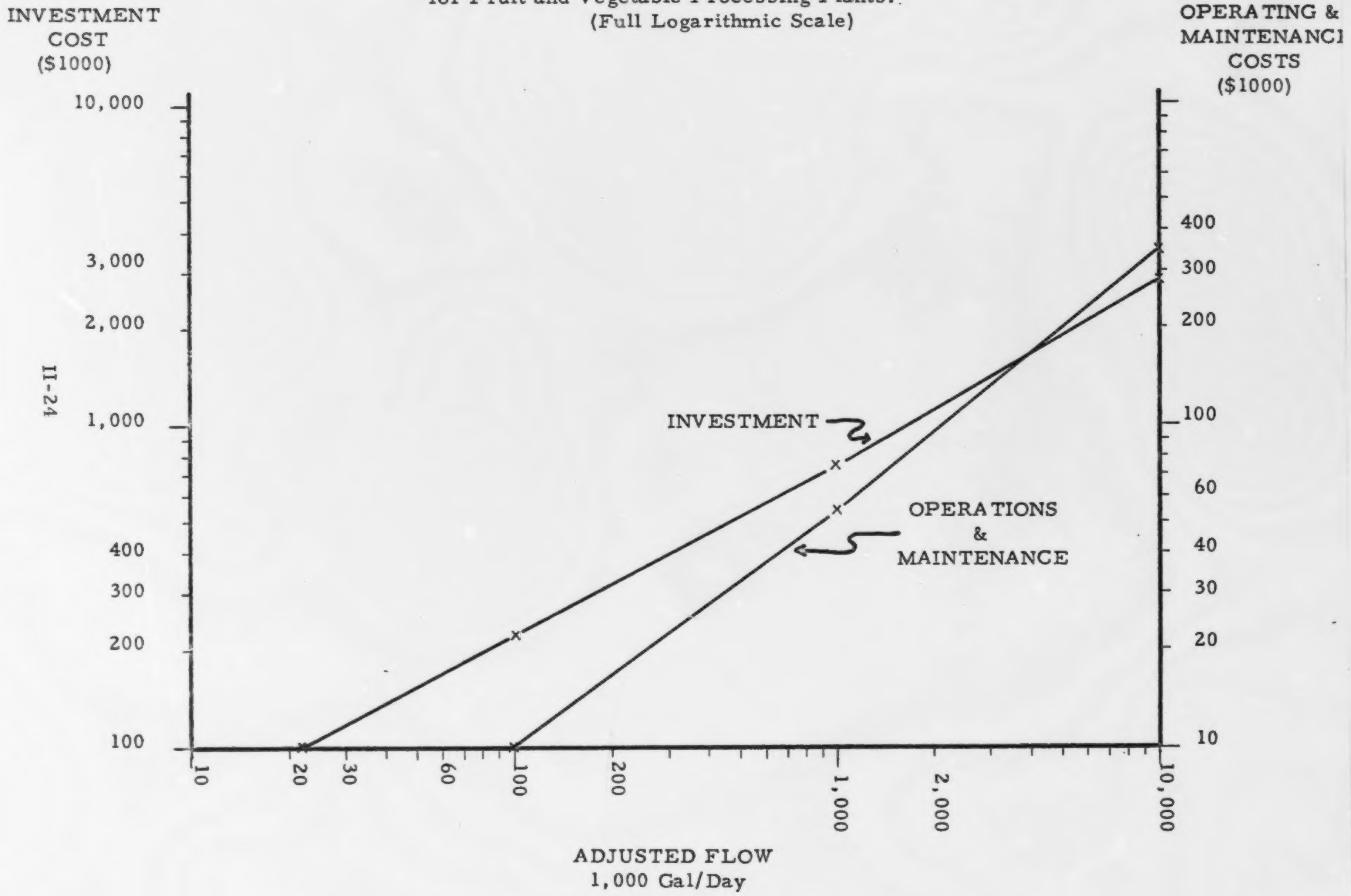
Method	Percent of Wasteflow Processed
Equalization	50
Flotation	100
Sedimentation	100
Biological stabilization	140

Actual flow of waste water through the above configuration is adjusted by a scaling factor of 2 for the fruit and vegetable industry. This is to account the differential between industries in the level of pollutiants in the waste water, i.e., bakeries, 1; leather, 41 pulp and paper, 6; steel, 1;, etc. The scaling factor is used as a simple multiplier for the adjustment but to the 0.6 power. This is to account for the economies of scale according to the CEQ. In other words, the actual flow of waste water from the fruit and vegetable industry is adjusted by 2.6 or 1.515.

Pollution abatement costs used in this study were derived from the relationship shown in Exhibit II-8. The actual waste flow was calculated on the basis of the kind of product processed and the number of cases per day. The actual flow was then multiplied by 1.515 to calculate the adjusted flow. The appropriate capital investment and operation and maintenance costs were then derived. It is significant to note that cost structure demonstrates significant average economics of scale however only very slight marginal economies of scale exist. If substantial marginal economies of scale in fact do exist in actual waste treatment plants, the larger firms will have an additional advantage over smaller firms.

These costs as presented are subject to variation under alternative conditions. CEQ recognizes that a reasonable range is from -30 percent to +30 percent.

Exhibit II-8. Estimated Pollution Abatement Costs by Unit of Water Flow (adjusted) for Fruit and Vegetable Processing Plants.
(Full Logarithmic Scale)



The total costs could reasonably be 30 percent lower because:

a. Many facilities can discharge to public sewers (10%).
b. Treatment configurations of equal effectiveness and lower costs are available (10%).
c. Improved hydraulic engineering could accelerate increase in water productivity and cause rapid reduction in treatment costs (10%).
d. There are tradeoffs between operations and capital costs that could lower capital costs (25%) and increase operating (25%).

The figures could reasonably be 30% higher because:

a. Current level of control could be 50% instead of 60% because previously installed facilities could be qualitatively inferior to those being installed today (15%).
b. Some localities may set standards that require additional treatment like activated charcoal (15%).

On a per unit basis the figures could reasonably be higher because:

a. Higher regional construction costs

Northeast	23%
Great Lakes	18%
Northern Plains	14%

b. Obsolete processes and hydraulic engineering (100%).
c. Lack of space for cost-effective treatment (100%).
d. If additional treatment like activated charcoal is required, costs could go up (40%).
e. There are configurations that could reduce capital costs 50% and increase operations costs 100%.

The figures could reasonably be lower because:
a. Treatment configurations of lower costs but equal effectiveness are available (50%).
b. Lower regional construction costs

Pacific Coast	32%
Southwest	29%
Southern Plains	34%
Southeast	18%

c. Improved hydraulic engineering (30%).
d. See e above.

This range was used in the sensitivity analysis for all plants considered.

The CEQ costs are concerned with the treatment of waste water once the effluent leaves the plant. Substantial costs however can occur within the plant in delivery of the waste water (and solids) from the many processing operations to a common outlet. This would include primarily flumes, pipes, pumps, tanks and sumps, gutters and screens. The National Canners Association in their study Solid Waste Management in the Food Processing Industry[1] collected some information relevant to this question during their site visits. The data was less extensive and less precise than that for solid wastes which constituted the focus of the study. In plant capital costs for handling waste water were reported to average $.90 per ton of raw material processed per year (adjusted to current data). Liquid treatment system, including aerated and evaporation ponds, activated treatment sludge systems, trickling filters, ponds and irrigation systems amounted to $7.10 per ton processed. The standard to which the water is treated is not known.

The costs as reported to the NCA survey team are generally considered by the NCA to be on the low side. Capital investment in an in-plant handling system amounts to only $900 for "small" plant; $3,375 for a medium plant and $18,000 for a large (appendix Table A-1). However, the capital investments in the treatment facilities are also low and for the small plant amount to $11,800 vs. about $250,000 according to the CEQ information. For the medium sized plant the NCA survey indicates an investment of $44,000 versus $350,000 for the CEQ facility and $236,000 for a large plant requiring an investment of about $700,000 to $800,000 according to the CEQ data.

The major point of this discussion is that there are additional costs involved in the treatment of the waste water from processing plants and this involves the in-plant cost. Although they are lower than the cost of the treatment facilities and much of the required configuration may already be installed in the plants, they do nevertheless represent additional pollution abatement costs for the industry.

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[1] National Canners Association, Solid Waste Management in the Food Processing Industry, pre-publication, Completed under contract with the Environmental Protection Agency.

III. INDUSTRY ANALYSIS

The basic methodological approach used in this analysis involves economic engineering-snythesis of cost and return data for individual representative processing plants within the fruit and vegetable industry. Because of the wide variety of data sources used for this analysis, the results should be viewed in a relative framework considering the impact of major variables such as size, capacity utilization, technology, pollution abatement costs, etc. on plant performance rather than an absolute comparison of actual performance of various sectors within the industry.

Also, it should be remembered that in the construction of the representative cash flows basic capital investment costs were inflated to present day levels. This necessary step to bring all the data to a more equal basis does in fact consider that each plant was built under current conditions. Most plants, however, were built earlier with lower investment cost and thus may operate profitably today because of the lower depreciation. They, however, might not be replaced in the same size configuration but at the end of their current useful life would be replaced with larger plants - or not replaced at all. The basic data used for the construction of the individual cash flows such as investment costs, operating cost, prices etc. are contained in Appendix Tables A-2 through A-11 and the results of the internal rate of return analyses are contained in Appendix Tables A-12, A-13 and A-14.

A. Economic Analysis of Representative Large, Medium and Small Plants by Key Products

Representative plants for which economic cash flows were developed are shown for the canning industry in Table III-1. Economic cash flows for both single line and multi-product canning plants were constructed. A small, medium and large plant was analyzed for the high volume lines of tomatoes, green beans, sweet potatoes and single strength orange juice. Based on average industry production, a small plant was developed with a throughput equal to the average throughput of the smallest 33 percent of the firms in the industry. Normally, this amounted to 80 to 200 cases per hour. Likewise, for the middle third, a representative plant was developed for each major product. Throughputs ranged from 170 to 400 cases per hour for the middle sized plants. Average size for large firms in each product line ranged from 600 to 1,500 cases per industry. Actual numbers of firms represented by each representative plant are given in Part II, Chapter III.

Approximately two-thirds of the plants (both canning and freezing) are multiproduct firms. These are represented by two simulated plants. Corn and peas in the three representative size categories are considered in the first plant. The second multiproduct plant includes sweet potatoes, carrots, green beans, leafy greens and peaches at one given size.

Table III-1. Capacities (Cases/Hour), Length of Operating Season and Annual Pack for Representative Canning Plants

Product	Size Plant (Cases/Hour)		Length of Season (Hours)	Annual Pack 24/303 Equiv.
Tomatoes	S	140	500	70,000
	M	300	750	225,000
	L	600	1,000	600,000
Green Beans	S	120	500	60,000
	M	330	750	24,750
	L	900	1,000	900,000
Sweet Potatoes	S	80	500	40,000
	M	280	750	210,000
	L	760	1,000	760,000
Multiproduct Plant				
Peas	S	100	500	50,000
	M	240	750	180,000
	L	1,500	1,000	1,500,000
Sweet Corn	S	100	500	50,000
	M	170	750	127,500
	L	1,000	1,000	1,000,000
Multiproduct Plant				
Sweet Potatoes		549	350	192,000
Carrots		1,000	200	200,000
Green Beans		773	400	309,000
Leafy Greens		430	240	103,000
Peaches		302	144	435,000
Total			1,334*	1,239,000
Canned SS Orange Juice	S	200	1,000	200,000 12/46 oz.
	M	400	1,000	400,000 " "
	L	1,000	1,000	1,000,000 " "

* Includes 12 weeks of double shift operation

Table III-2 gives the product, plant size and length of season for representative freezing plants. Frozen orange juice concentrate is considered at plants of three different size levels ranging from 200 to 1,500 cases per hour (700 cases per hour is approximately the over-all industry average). A multiproduct freezing plant for vegetables is represented by a green beans, carrots and leafy greens combination. In this plant the three products are considered in a series with the total season amounting to 840 hours on a one shift per day basis. When two shifts per day are considered, the length of processing is extended to 1,680 hours.

For each of the plant types considered the size variable was analyzed, and in each case size proved to be a major factor in the level of returns. A summary of all the internal rates of return is presented in Appendix Tables A-1 and A-2, and three plants are used here for illustration. A multiproduct plant, canned corn and peas, is used throughout this analysis and other plants are used to supplement the discussion.

Exhibit III-1 shows the impact of size on the canned corn and peas plant. For the small plant the internal rate of return is 7 percent, increases to 18 percent for the medium size plant and to 50 percent for the large plant operating at 75 percent capacity. When pollution abatement costs are applied to the industry, without an increase in revenue, the internal rates of return are reduced about 7 percentage points . For the small plant and medium plants this represents a reduction in the rate of return to about the 0 level. For the large plant the rate of return is reduced by 15 percentage points.

The results of the analysis for a canned single strength orange juice plant are shown in Exhibit III-2. The results follow a similar pattern. The internal rate of return increased from a marginal 1 percent in the small plant to 8.0 in the medium plant and 18 percent in the large. In this case the rate of return is reduced to a -4.0 percent for the small plant, 3 and 10 percent for the medium and large plants respectively.

Frozen concentrated Orange Juice represents similar economies of scale for plants of various sizes but the smaller plants operate with a higher level of return (Exhibit III-3). With pollution abatement costs the internal rate of return is reduced by 11 percentage points for the small plant, 13 for the medium sized plant and 15 percentage points for the large. This represents a reduction of return by 45 percent for the small plant, 33 percent for the medium sized plant and 30 percent for the large plant.

Exhibit III-1. Summary of the Internal Rates of Return for Multiproduct Corn and Peas Canning Plant as Related to Size of Operation (75% capacity)

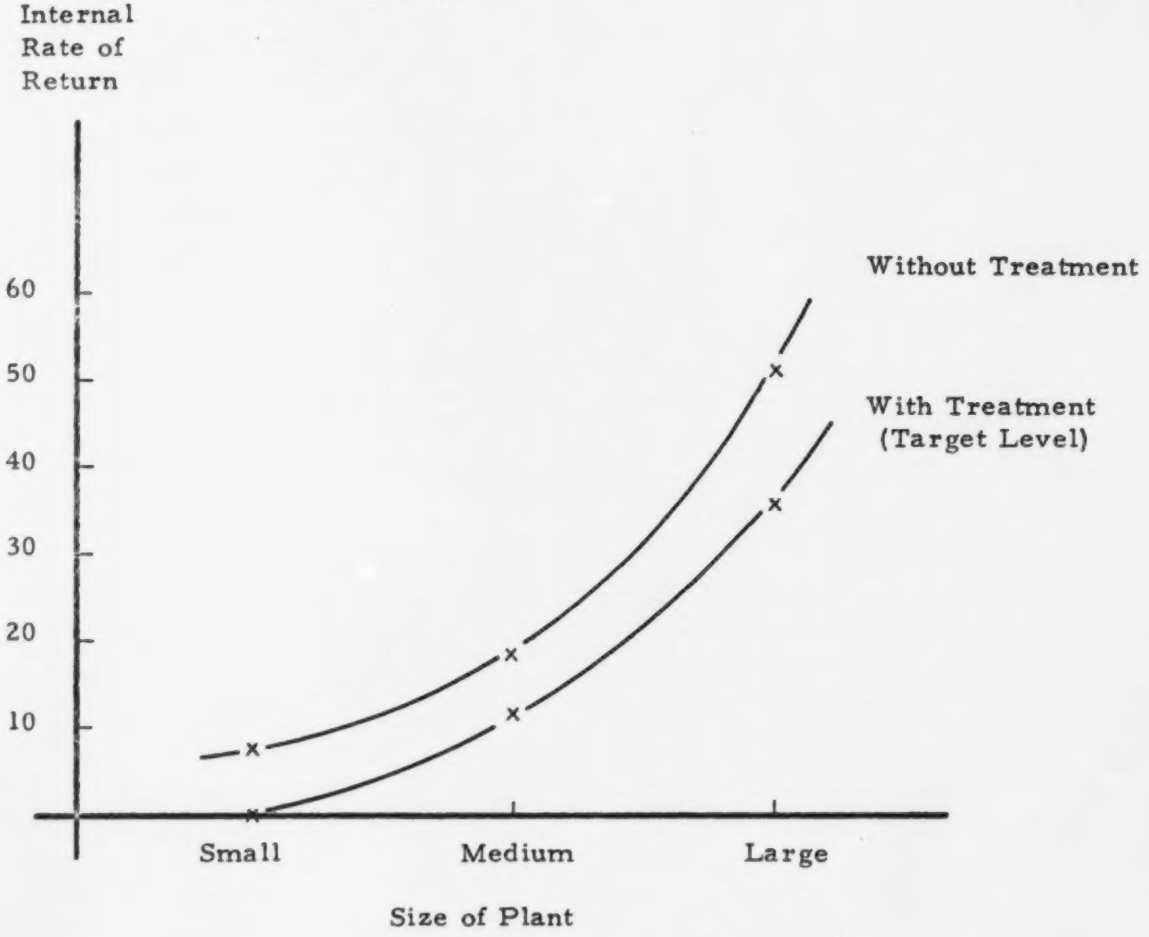


Exhibit III-2. Summary of the Internal Rates of Return for a Canned Single Strength Orange Juice Plant (100% capacity) as Related to Size of Operation

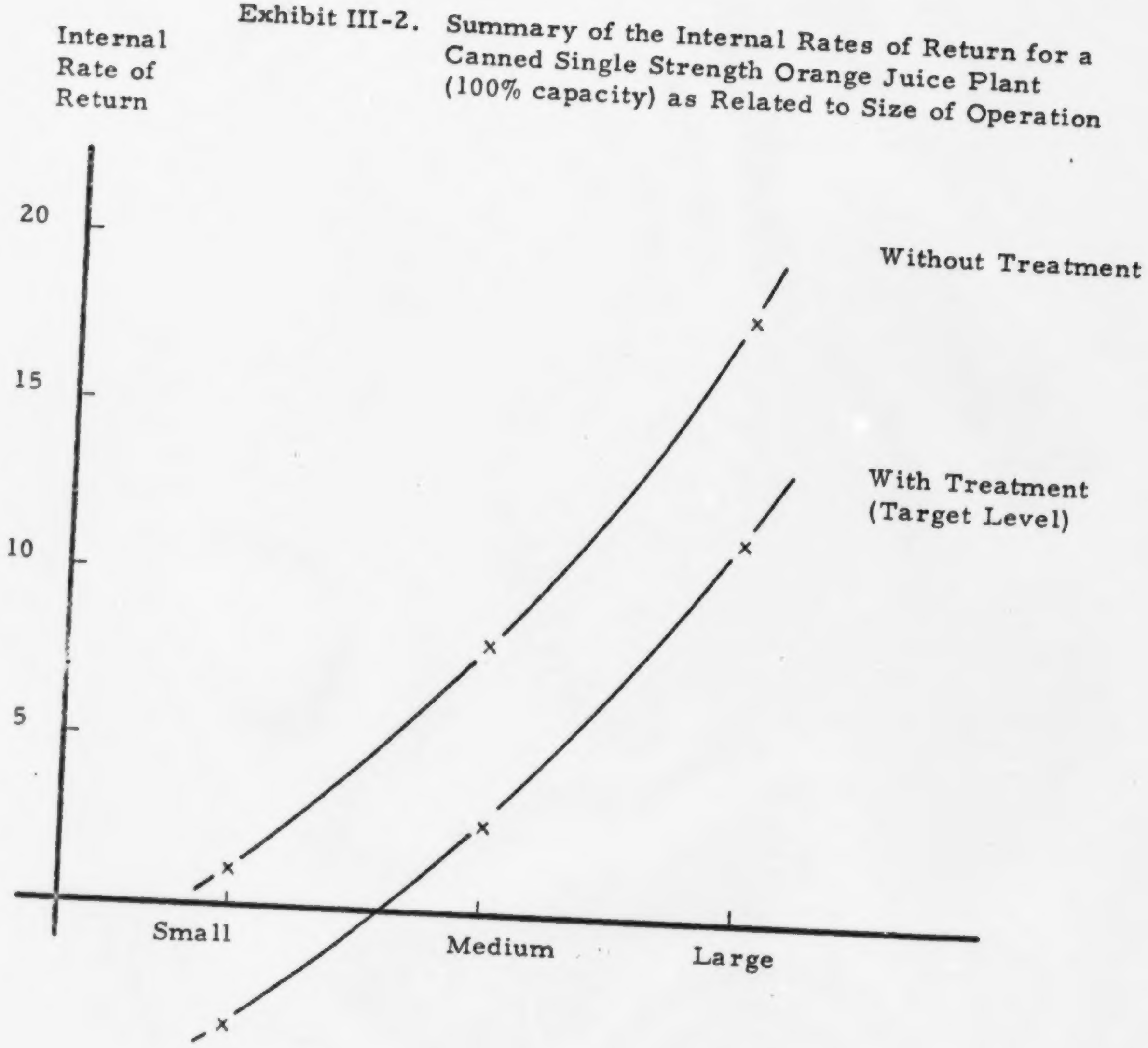
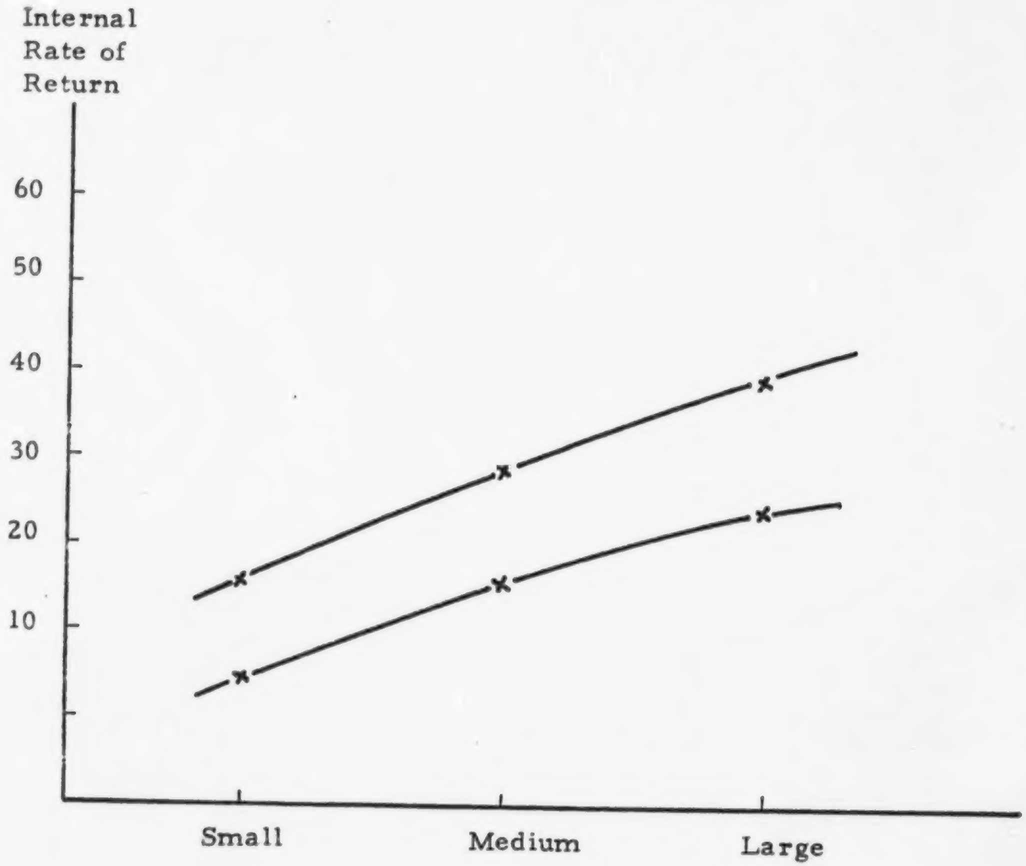


Exhibit III-3. Summary of the Internal Rate of Return for a Frozen Concentrated Orange Juice Plant as Related to Size of Operation (75 percent capacity)



B. Utilization of Plant Capacity

It is generally recognized that the fruit and vegetable plants are currently operating at a level of less than capacity (see Part II, Chapter III, Section F). To assess this, variable cash flows were developed for representative plants operating at 100 percent and at 75 percent of plant capacity. Because the throughputs used are representative of actual average size throughputs plant sizes and operating costs were adjusted upwards to represent a large sized plant operating at 75 percent of capacity but with the throughputs shown in Tables III-1 and III-2.

Table III-2. Capacities, Length of Operating Season, and Annual Pack for Representative Freezing Plants

Product		Size Plant	Length of Season (Hours)	Annual Pack
Frozen orange	S	200 cases/hr.	1,000	200,000 48/6 oz. cases
juice concentrate	M	700 cases/hr.	1,000	700,000 " "
	L	1,500 cases/hr.	1,000	1,500,000 " "
Multiproduct Plant (Products considered jointly)				
Green Beans		12,750 lbs./hr.	400	5,100,000 lbs.
Carrots		7,150 lbs./hr.	200	1,430,000 lbs.
Leafy Greens		5,600 lbs./hr.	240	1,344,000 lbs.
Total			840	7,874,000 lbs.
Green Beans		12,750 lbs./hr.	800	10,200,000 lbs.
Carrots		7,150 lbs./hr.	400	2,860,000 lbs.
Leafy Greens		5,600 lbs./hr.	440	2,688,000 lbs.
Total			1,680	15,748,000 lbs.

Utilization of plant capacity directly impacted the return on invested capital. For the small plant, returns were reduced from 14 percent to 7 percent when capacity utilization was reduced from 100 percent to 75 percent (Exhibit III-4). Similar results were obtained for the medium sized plant with the internal rate of returns decreasing from 26 to 18 percent and for the large plant returns dropped from 70 to 50 percent. Returns with treatment facilities were then reduced by about 7 percentage points for the small and medium sized plants and about 15 percentage points for the large plant.

A comparison was also made with the frozen concentrated orange juice plants. Returns were more sharply reduced resulting from a higher level of fixed plant investment. Returns were reduced from 80 to 49 percent for the large plant, 78 to 38 percent for the medium sized plant and from 63 to 26 for the small sized plant.

C. Length of Operating Season

One of the critical variables in the fruit and vegetable processing is length of operating season. Because raw product availability is limited to specific short seasons, a single line plant may operate for as little as 2 months. Other multiproduct firms may operate for as long as 9 months or more. With secondary processing, the plant may be operated on nearly a year-around basis.

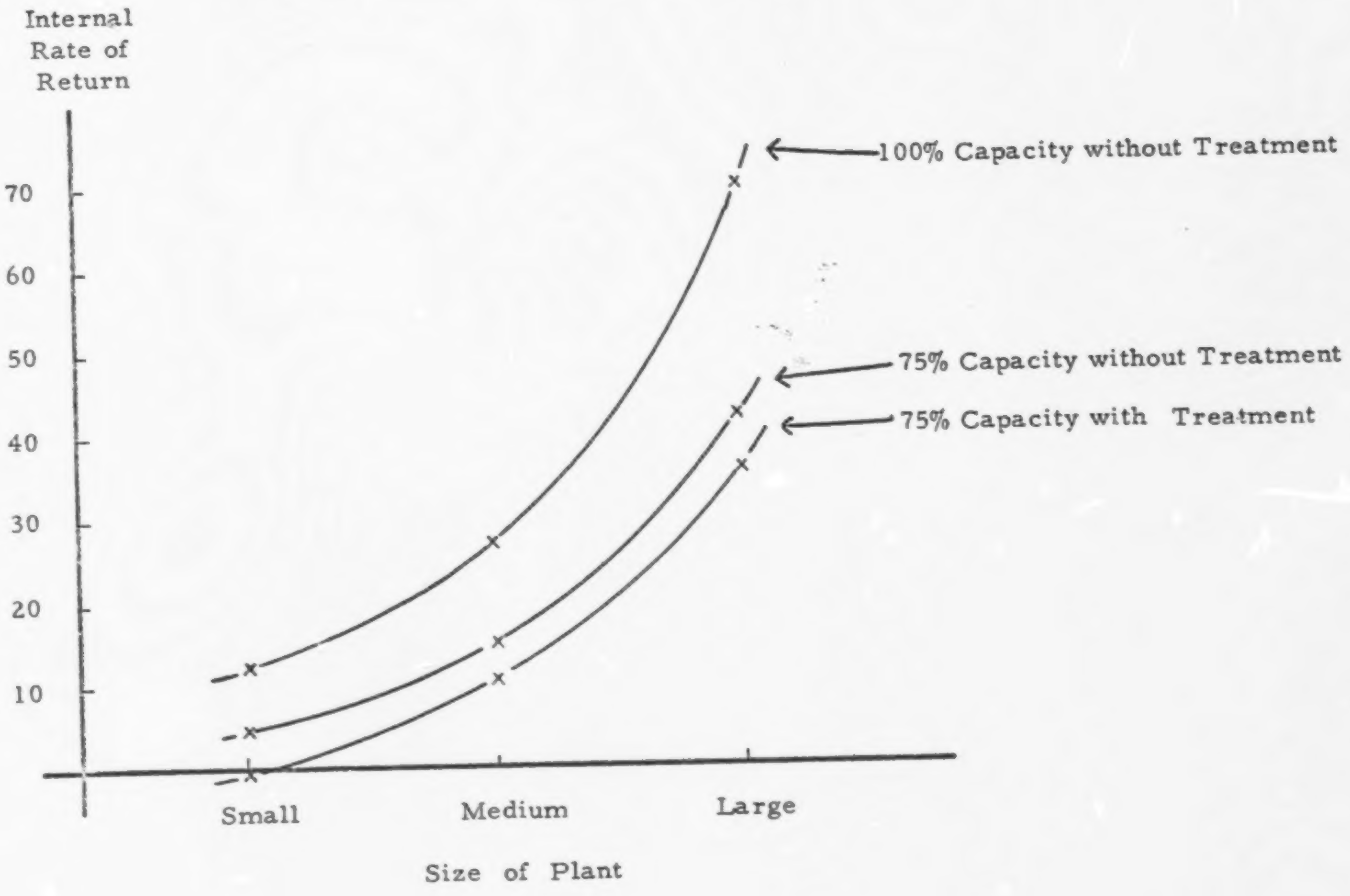
Much effort is made to extend the annual operating season by hauling raw product from the south early in the year and/or hauling from the north late in the season. By processing a variety of products the season may be extended. Also by operating on a 2 shift per day basis - or even 3 shifts per day - the effect of a longer season is obtained.

In our analysis the larger plants were assumed to operate under a longer season (see Table III-1). However, for the multiproduct green beans, carrots and leafy greens freezing plant the same size plant was operated on a one-shift basis, then on a double-shift basis. The internal rate of return was increased from a negative to 9 percent without treatment and from a negative to 3 percent with waste treatment facilities considered.

D. Level of Technology

Level of technology is difficult to assess in the fruit and vegetable industry. Many of the plants are relatively old, but throughout their useful life new

Exhibit III-4. Summary of the Internal Rates of Return for Multiproduct Corn and Pea Canning Plant as Related to Utilization of Plant Capacity



equipment has been added or used to replace that which is old or technologically obsolete. As a result, most plants in the industry are a combination of old and new equipment. Generally, the newer equipment installed represents a higher level of technology than the old.

In a recent survey by the National Canners Association the age of plants was investigated. [1] Approximately 200 plants were surveyed and the approximate years at the site is given in Table III-3 along with the years since the last expansion (Table III-3 also contains Seafood and Specialty plants). Only 13 percent of the plants were less than 10 years of age and 8 percent from 10-19 years. Seventy-nine percent of the plants were located at the same sight for more than 20 years. Sixty-two percent of the plants have undergone a major expansion program in the last five years, however, and another 19 percent had undergone expansion moves since 1960. Nineteen percent had not expanded since 1959 or earlier.

A large majority of the plants surveyed in the New England, North Central and Mountain Regions were over 40 years old. By commodity the oldest plants spread throughout the three classifications of fruit, tomato and vegetable canning plants. By comparison the Seafood and Specialty plants were relatively newer.

To arrive at some level of efficiency for plants in various age categories (assumed to reflect the level of technology) the Department of Interior report The Cost of Clean Water, Volume II, No. 6, [2] was used. The capital costs and annual operating and maintenance costs were estimated for old (1950), prevalent (1963) and new (1967) plants. These estimates were converted to an index of investment and operating costs for the representative plants (Table III-4). Application was then made to the multiproduct corn and peas canning plant and a cash flow developed. Runs were made to appraise the impact on technology for various size plants operating at 100 percent of capacity and at 75 percent. The results for plants operating at 75 percent of capacity are shown in Exhibit III-5 and a summary of all runs is contained in Appendix Table A-3. Even though capital investment costs are considerably lower in the older plants, higher operating cost generally offsets the advantage and results in a lower rate of return than newer plants. For a large plant with no pollution abatement facilities, returns are reduced from 42 percent in a new technology plant to 33 percent for prevalent technology and to 29 percent for old technology. A similar pattern exists for medium size plants, but older small plants perform at about the same level as the new plants. In other words, the older small plants are able to compete reasonably well with the newer ones.

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[1] National Canners Association.

[2] The Cost of Clean Water, Vol. III, Industrial Waste Profile No. 6, Canned and Frozen Fruits and Vegetables, FWPCA, U.S. Dept. of Interior, 1967.

Table III-3. Percent of Canning Plants in Various Age Groupings by Location and Commodity and Years Since Last Major Expansion

	Location									
Years at site	New England	Middle Atlantic	South Atlantic	North Central	South Central	Mountain	North-west	Alaska	South-west	Total
0 - 9	8	9	9	9	16	0	17	30	14	13
10 - 19	8	9	12	5	5	0	11	10	9	8
20 - 39	8	34	49	16	53	27	49	25	34	33
40 - 59	53	34	21	50	21	46	18	10	37	33
60+	23	14	9	20	5	27	5	25	6	13
Total	100	100	100	100	100	100	100	100	100	100
Years since last expansion										
65 - 69	46	55	64	62	68	50	63	85	60	62
60 - 64	8	25	12	22	5	20	21	5	20	19
50 - 59	8	8	18	11	16	10	9	10	12	11
Before '50	38	12	6	5	11	20	7	0	8	8
Total	100	100	100	100	100	100	100	100	100	100

	Type				
Years at site	Fruit	Tomato	Vegetable	Seafood	Specialty
0 - 9	9	9	10	17	14
10 - 19	8	0	7	15	13
20 - 39	40	30	32	26	30
40 - 59	34	45	40	23	30
60+	9	16	11	19	13
Total	100	100	100	100	100
Year since last expansion					
65 - 69	53	61	64	63	67
60 - 64	23	17	22	7	16
59 - 59	14	15	7	15	10
50-	10	7	7	15	7
Total	100	100	100	100	100

Source: National Canners Association

Table III-3. Percent of Canning Plants in Various Age Groupings by Location and Commodity and Years Since Last Major Expansion

	Location									
Years at site	New England	Middle Atlantic	South Atlantic	North Central	South Central	Mountain	North-west	Alaska	South-west	Total
0 - 9	8	9	9	9	16	0	17	30	14	13
10 - 19	8	9	12	5	5	0	11	10	9	8
20 - 39	8	34	49	16	53	27	49	25	34	33
40 - 59	53	34	21	50	21	46	18	10	37	33
60+	23	14	9	20	5	27	5	25	6	13
Total	100	100	100	100	100	100	100	100	100	100
Years since last expansion										
65 - 69	46	55	64	62	68	50	63	85	60	62
60 - 64	8	25	12	22	5	20	21	5	20	19
50 - 59	8	8	18	11	16	10	9	10	12	11
Before '50	38	12	6	5	11	20	7	0	8	8
Total	100	100	100	100	100	100	100	100	100	100

	Type				
Years at site	Fruit	Tomato	Vegetable	Seafood	Specialty
0 - 9	9	9	10	17	14
10 - 19	8	0	7	15	13
20 - 39	40	30	32	26	30
40 - 59	34	45	40	23	30
60+	9	16	11	19	13
Total	100	100	100	100	100
Year since last expansion					
65 - 69	53	61	64	63	67
60 - 64	23	17	22	7	16
59 - 59	14	15	7	15	10
50-	10	7	7	15	7
Total	100	100	100	100	100

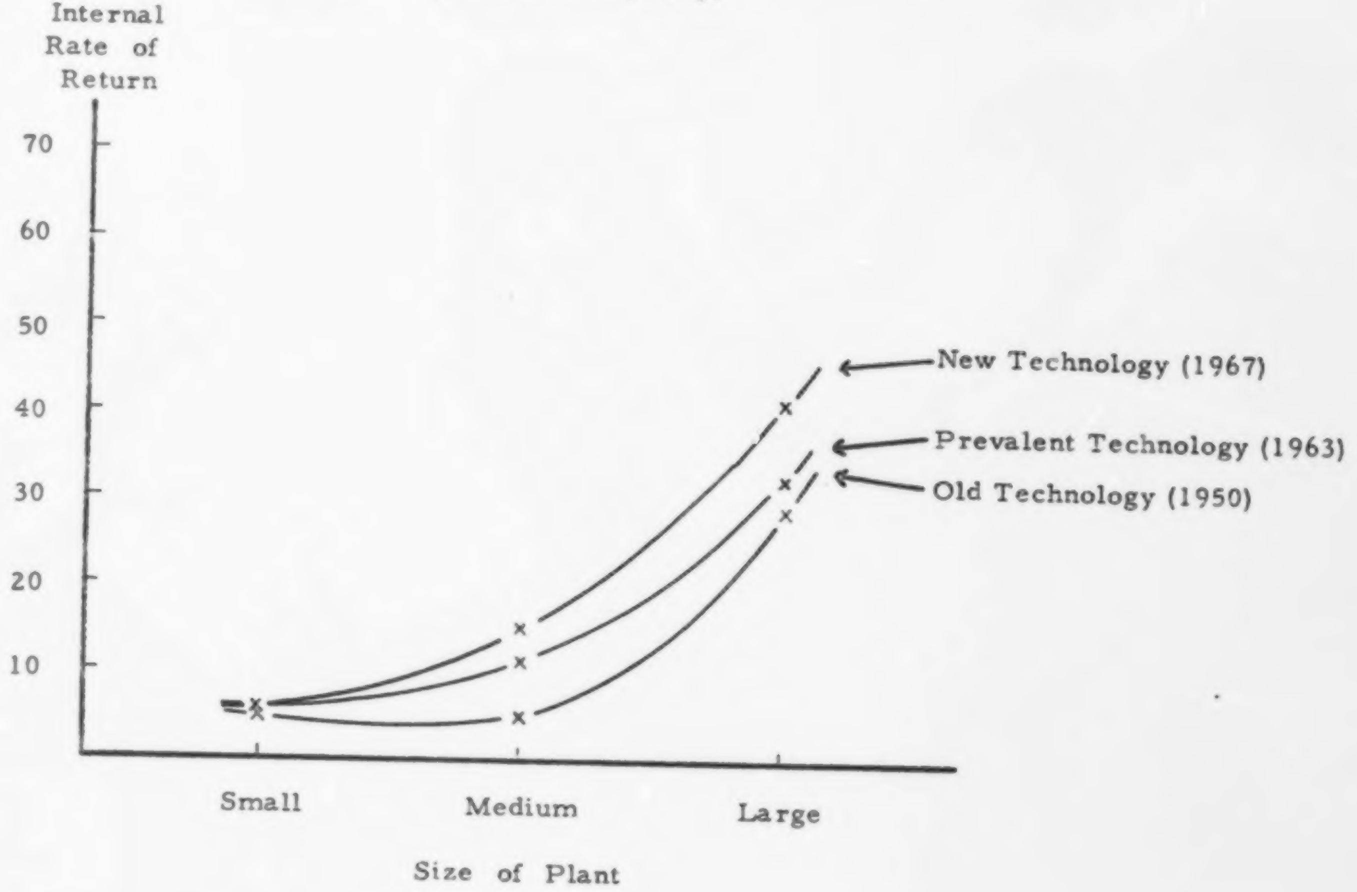
Source: National Canners Association

Table III-4. Index of Investment and Operating Costs for Old, Prevalent, and New Technology by Size of Plant

	Small Plant 2,000 cases/day		Medium Plant 10,000 cases/day		Large Plant 30,000 cases/day	
	Capital Cost	Annual O&M	Capital Cost	Annual O&M	Capital Cost	Annual O&M
Old Technology (1950)	62	107	62	115	58	114
Prevalent Technology (1963)	80	100	85	107	83	108
New Technology (1967)	100	100	100	100	100	100

Source: Adapted from The Cost of Clean Water, Vol. III, Industrial Waste Profile No. 6, Canned and Frozen Fruits and Vegetables, FWPCA, U. S. Dept. of Interior, 1967.

Exhibit III-5. Summary of the Internal Rates of Return for Multiproduct Corn and Peas Plant as Related to Level of Technology
(at 75 percent of capacity)



E. Impact of Pollution Abatement Costs

The impacts of pollution abatement costs at the micro level were evaluated, in part, by increasing revenues for the firm with abatement costs, to the level where the firm was operating with the same internal rate of return as experienced before pollution control. In effect this demonstrates the percent increase in revenues (or prices) required to cover the pollution abatement costs for a given firm.

The impact of pollution abatement costs were analyzed for each product grouping and a sensitivity analysis conducted for each. Differences were found between commodities which can largely be explained by the level of effluent and the rate of return experienced by the plant prior to pollution abatement costs. An attempt was made to represent various levels of waste effluent by product. Although a great deal of variability actually exists in the industry, products do fall into patterns.[1/] Low levels of waste water volumes ranging from 25 to 50 gallons per case such as apples, cherries, cranberries, Lima beans, etc. are represented by Single Strength Orange Juice with an average of 40 gallons per case. Medium waste water levels -- 50-70 gallons per case -- such as apricots, peaches, asparagus, beets, etc. are similar to corn and peas (53), Tomatoes (59) Green Beans (60) and frozen orange juice concentrate (72). Sweet Potatoes average about 90 gallons of waste water per case. Most products fall into these categories. Leafy greens and spinach are reported to have a very high level of effluent with an average of 180 gallons per case.

The multiproduct freezing plant is assumed to process all leafy greens during part of the season so was given a high level of effluent at 180 gallons per case. The multiproduct canning plant processed both leafy greens and green beans during a given period so was given an average level of effluent of 130 gallons per case to allow for the product combination (Table III-5).

The rate of return for various products also had to be taken into consideration. For example, if a plant is operating at a high level of return, i.e., 40 percent, it will take a large increase in revenue to bring the returns on the capital invested in pollution abatement facilities up to 40 percent than a same sized abatement facility operating at a lower level of return (i.e., 20 percent). This is especially true in the internal rate of return analysis where investment costs are included in Year 1 and revenues occurring year after year are subjected to discounting. Higher rates of return are, of course, subject to the much higher level of discounting.

[1/] Effluent levels taken from The Cost of Clean Water No. 6, Canned and Frozen Fruits and Vegetables, FWPCA, U.S. Dept. of Interior, 1967 and National Canners Association.

To provide a better understanding of this situation percentage increases in revenues were estimated to bring the rate of return on pollution abatement facilities up to the level experienced by the plant before abatement costs were added. Also percentage increases in revenues were estimated to bring the rate of return for pollution facilities to a standard level, i.e., 15 percent and 20 percent. The results are discussed in the following Section.

Sensitivity Analysis

An analysis of the corn and pea canning plant is representative of the relationship among various size plants processing the same commodity (Exhibit III-6). Price increases were made at the 1 percent, 5 percent and for the 10 percent for all plants. The rates of return were then interpolated to identify the new price level which would provide sufficient revenue to offset the abatement costs. For the large plant a 6.3 percent increase in product revenue is required, for the medium sized plant a 8.6 percent increase is required and 11.0 percent for the small plant.

For the sensitivity analysis the pollution abatement costs were altered by 130 for the upper bound and 70 for the lower bound. This was for both investment cost and operation and maintenance cost. The revenue increase for the large plant under these conditions ranges from 4.4 to 8.1 percent. For the medium size plant the range is 6.1 to 10.3 percent and for the small the range is 7.7 to 12.6.

The percent increase in revenue required to offset the additional cost of pollution abatement facilities is slightly higher for the corn and peas plant than for the simple average of all plants considered (Table III-5). Average price increases for the large plants amounted to 5.5 percent with a sensitivity range of 3.9 to 7.5 percent. A higher percentage increase is required by the medium sized plant with an average increase of 6.4 percent and a range of 4.6 to 8.1 percent.

It was not possible to directly calculate a similar mix for the small plants. This is because the plants for tomatoes, sweet potatoes and multiproduct freezing yielded negative results in the initial internal rate of return analysis. However the water usage for all plants averaged 89 gallons compared with 55 gallons for the three analyzed. Therefore it can be safely assumed that the cost for pollution abatement facilities for all plants would be slightly higher and then require a higher percentage increase in revenue to offset.

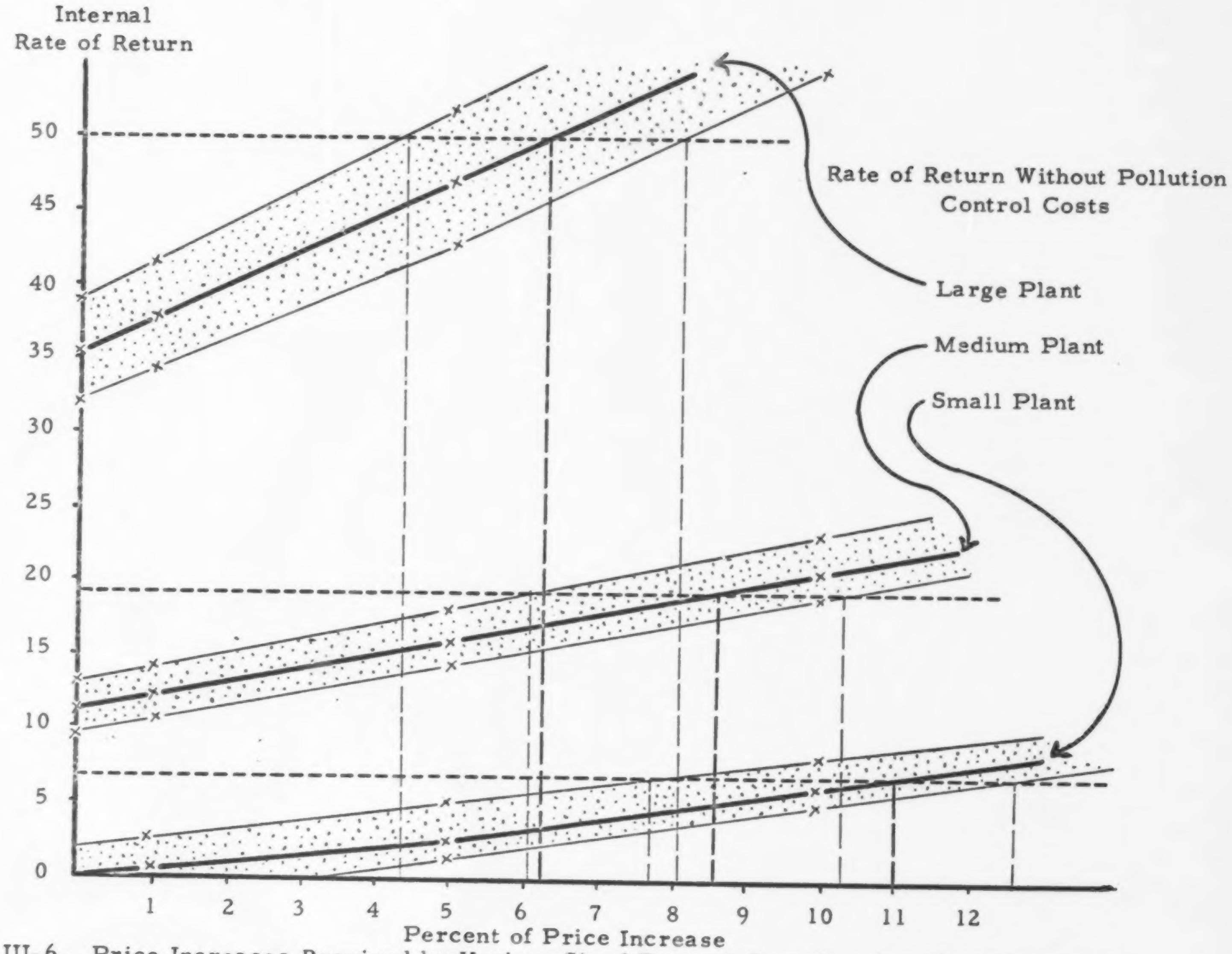


Exhibit III-6. Price Increases Required by Various Sized Pea and Corn Canning Plants to Offset the Estimated Cost of Pollution Abatement Facilities (Plus or minus 30 percent)

Table III-5. Price Increases Required by Various Sized Plants to Offset the Estimated Cost of Pollution Abatement Facilities

Type	Gal/ Case	Internal Rate of Return	Large			Internal Rate of Return	Medium			Internal Rate of Return	Small		
			-30%	Tar- get	+30%		-30%	Tar- get	+30%		-30%	Tar- get	+30%
Canning Plants													
1. Corn & Peas	53	50.3	4.4	6.3	8.1	18.2	6.1	8.6	10.3	7.4	7.7	11.0	12.6
2. Single Strength Orange Juice	40	16.4	1.9	2.8	3.6	8.0	2.3	3.3	4.3	5.0	4.8	5.9	7.0
3. Tomatoes	59	16.4	2.7	4.0	5.0	1/				1/			
4. Sweet Potatoes	90	39.1	7.8	10.8	13.6								
5. Multi Product*	130					17.7	5.9	8.1	10.7				
Freezing													
6. Orange Juice Concentrate	72	49.1	3.6	5.3	9.2	38.5	3.9	5.5	7.0	25.6	5.2	7.3	9.4
7. Multi Product**	180	8.5	2.8	4.0	5.2	1/				1/			
Average plants No. 1, 2, & 7	55	38.6	3.3	4.8	7.0	21.6	4.1	5.8	7.2	12.7	5.9	8.1	9.7
Average, all plants	89	29.9	3.9	5.5	7.5	20.6	4.6	6.4	8.1				
			.6	.7	.5		.5	.6	.9				

1/ Negative results

*Sweet Potatoes, Carrots, Green Beans, Leafy Greens, Peaches.

**Green Beans, Carrots, Leafy Greens.

An analysis was completed for all sized plants for three commodities including 1) Corn and Peas, 2) Single Strength Orange Juice and 6) Orange Juice Concentrate. (A similar analysis was not possible for the remaining products because the small and medium size plants did not yield a positive return on invested capital.) The three products had an average water consumption use of 55 gallons per case and as a result the increased revenue required to offset pollution abatement cost was slightly less than for the average of all plants considered. For the large plants an increase in revenue of 4.8 percent is required with a sensitivity range of 3.3 to 7.0 percent. The medium sized plants require an increase of 5.8 percent with a range of 4.1 to 7.2. A target increase of 8.1 percent is required for the small plants with a range extending from 5.9 to 9.7 percent.

Many of the canning plant owners and managers are inclined to keep fixed investment costs to a minimum and increase operating costs. To test this concept in terms of pollution abatement costs, a cash flow was developed reducing the investment in pollution abatement facilities by 50 percent and increasing operating cost by 100 percent. Although there would be some short term advantage and advantage in raising the capital required for the facility, the rate of return is nearly identical to the higher cost facility over a 20-year time period.

A special analysis was conducted for the canned corn and pea plants to offset the impact of the differential experienced with the internal rates of return. The cash flows were developed with only the waste treatment costs included and incremental revenue. The analysis was conducted at alternative increase in revenue, then interpolated to determine the percent increase in revenue to yield a rate of return on pollution abatement costs of 15 percent and again at 20 percent. (This would approximate a return of 7.5 and 10.0 percent after taxes).

To achieve an internal rate of return of 15 percent prices would have to be increased by 3.6 percent for the large plant with a range of 1.8 to 4.6 percent for abatement costs of + or - 30 percent. For the medium size plant a 6.7 percent increase in revenue is required with a range of 4.7 to 8.7 percent. The percentage increase in revenue is increased to 12.6 for the small plant with a range of 9.1 to 15.3. When the internal rate of return is increased to 20 percent the required revenue increases are increased to 4.0, 7.7 and 14.3 percent respectively.

Cost of Municipal Sewage Treatment Facilities

A definite lack of information on actual costs of disposing of waste water through municipal sewage treatment facilities exists. In those cases where the National Canners Association obtain municipal sewage charges in their survey many of the rates were obviously subsidized by the municipality and did not reflect the true costs. To overcome this problem an attempt was made to estimate the cost of a municipal sewage treatment facility with the cost information supplied by CEQ and the daily throughput of water on a per capita basis. This information was obtained by an informal telephone survey of local municipalities.

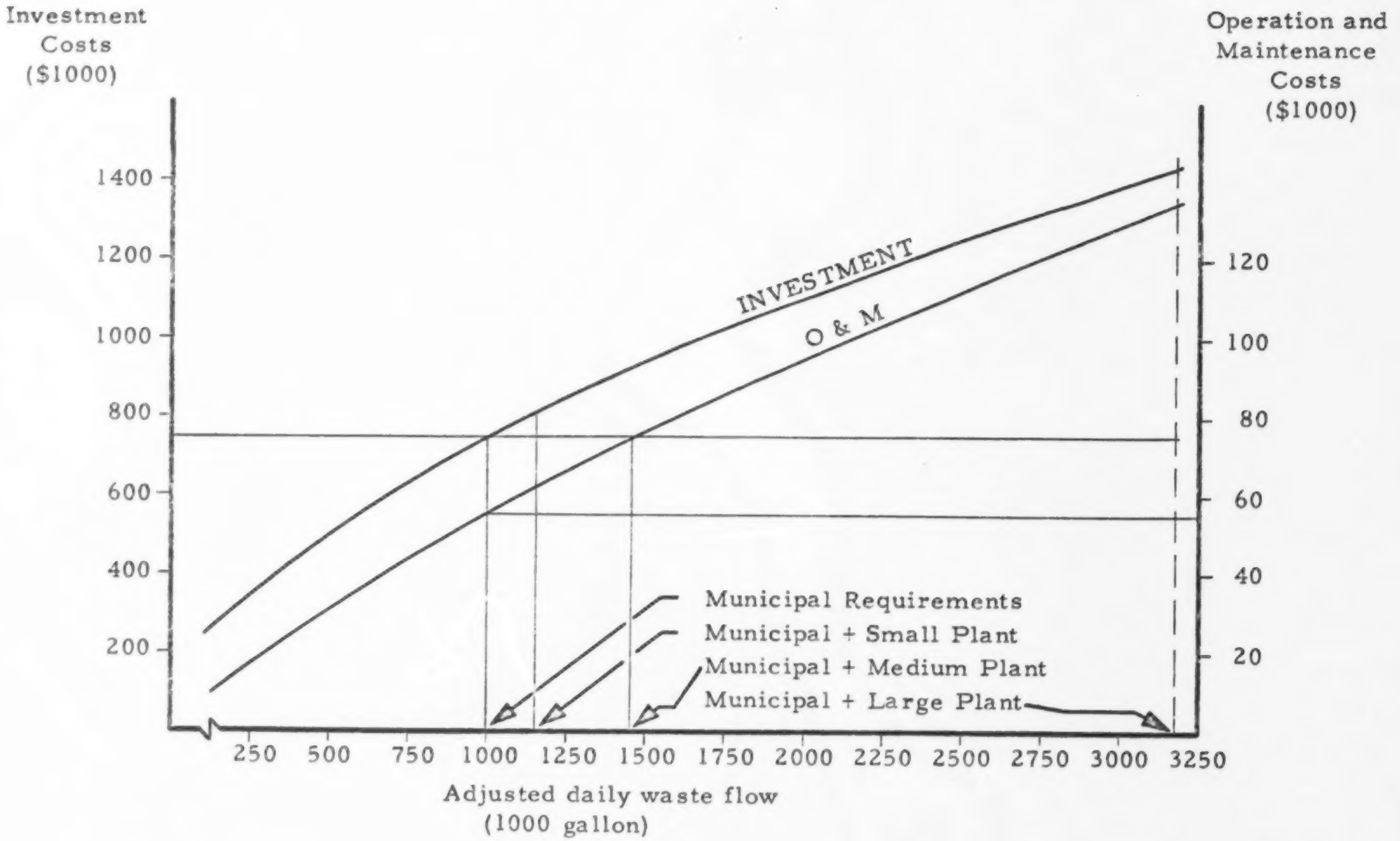
Assuming the processing plant was located in or near a municipality of 5,000 people with average waste water flow of 200 gallons per capita, the city would then be required to process 1,000,000 gallons of waste water daily. A plant adequate to process the level of effluent would require a capital investment of $746,000 and an annual operating cost of $55,000.

The estimated effluent from various sized corn and pea plants and single strength orange juice plants was added to the base developed by the city. The required incremental cost then was applied to the processing plant. Because of the nature of the pollution facilities cost curves developed by CEQ only very slight marginal economies of scale are realized but substantial average economies of scale exist. As a result, for equal rates of return, i.e., 15 or 20 percent, the incremental price increase required of offset the pollution abatement costs for the large plant is only slightly higher than for the small.

The incremental pollution abatement costs for the corn and peas plant is shown graphically on Exhibit III-7. The small plant requires facilities for additional waste effluent of only 159 thousand gallons per day and the incremental capital investment cost for this increment is only $54,000 compared with $280,000 if the plant had to construct its own facilities. The incremental capital investment required for the medium size plant $179,000 compared with $495,000 for independent facilities; for the large an incremental capital investment of $704,000 is required versus $1,160,000 for independent facilities. Similar patterns exist for operating capital.

To achieve an internal rate of return of 15 percent on the municipal facilities the large corn and pea plant requires an incremental increase in revenues of 2.5 percent with a range of 1.6 to 3.1 percent for varying the

Exhibit III-7. Pollution Abatement Costs by Unit of Water Flow for Corn and Pea Canning Plants Discharging Into a Municipal System.



investment cost by + or - 30 percent. The medium plant requires a 3.1 percent increase with a range of 2.4 to 3.9 percent and the small plant requires a 3.2 percent increase with a range from 2.5 to 4.2 percent.

For the single strength orange juice plant an increase in revenue of 1.3 percent was required to offset municipal sewage disposal. The relevant range for these costs was 1.1 to 1.8 percent.

F. Current Levels of Compliance

The overall impact of pollution abatement costs on the fruit and vegetable processing industry will depend, to some degree, on where the industry currently stands in regard to waste treatment activities. It must be kept in mind that the industry is not starting from a zero level of waste treatment. Most processing firms have engaged in some form of waste treatment. In recent years the industry has accelerated efforts to improve and upgrade its waste treatment facilities.

Total investments required for pollution abatement facilities in the fruit and vegetable industry have been estimated, by the Council on Environmental Quality, at about $289 million (current value). However, a large portion of this total requirement, namely $167 million (current replacement value) is estimated to be already invested. Thus, the difference of $122 million represents a preliminary estimate of additional investment capital which will be needed.

Yet there is very little published information to provide a precise estimate of how far along individual plants or even the industry within a state or region is in reading a generally accepted level of waste treatment performance.

There are surveys which provide data on estimated waste flow and where the waste is discharged. These data do not, however, reveal much information about the level of treatment of this waste flow.

In order to gain what might, at best, be characterized as a rough "feel" for the present level of compliance in the fruit and vegetable processing industry, a telephone survey of top state pollution control officials in several states was conducted. Officials in the following eleven states were contacted: Florida, Indiana, Maine, Maryland, Michigan, New York, North Carolina, Ohio, Oregon, Virginia and Washington.

In general, there was agreement that a great deal is being done by firms in the fruit and vegetable processing industry to improve and modernize waste treatment facilities. Yet, there is also general agreement that a great deal of future investment by the industry will be necessary.

In most states there was a feeling that the larger plants had moved much further than small or medium sized plants. Therefore, the impact of additional investments and costs will be felt more heavily by the small plants. This general conclusion seemed to be universal from one state to another.

In some instances there have already been dislocations resulting from pollution control requirements. In several instances plants have found it necessary to move to another location, within a given state, in order to have adequate space for pollution abatement facilities.

Many firms have built their own facilities while others have tied in to municipal facilities. Several state officials indicated that small municipalities were often reluctant to commit their governmental unit to a long-term debt load for a treatment facility capable of accommodating a food processing plant. Local governmental officials are unstandably concerned that, with current economic trends in the food industry, the potential exists for the major users of the treatment to cease operations. If debt retirement were planned on the basis expected user charges, then a municipality might well find itself in an untenable situation. As a matter of fact, bonding firms are often reluctant to participate in situations where water or sewer facilities are dependent on a single major industrial user for revenue expectations.

This places the small municipality in a rather difficult situation, since in most instances the processing plant is often the major source of employment for the community.

In those states where fruit and vegetable processors have connected to municipal sewer systems, the arrangement has been worked out under a rather tight agreement between the municipality and the processing firm. Several states cited instances where small towns had, in earlier years, signed agreements to treat waste from processing firms without clear--cut understandings about volume of waste. Subsequently, most were faced with waste load well beyond the capacity of their treatment facilities.

This is not to suggest that no municipalities are taking on the waste load of fruit and vegetable processing plants. The Cost of Clean Water indicates 62 percent of the canning industries waste water and 26 percent for the freezing industry is discharged into municipal sewers. Another survey indicated that a higher proportion of food industry waste is discharged into public treatment facilities than for manufacturers as a whole -- 38 percent for canned and frozen fruits and vegetables compared to 7 percent for all manufacturing. Another survey, by the National Canners Association, involving one hundred and nineteen plants in the Southwest, Northwest and Mountain regions showed that 57 percent were connected to public treatment facilities. Since the

National Canners Survey was admittedly directed toward larger plants, the difference between the two surveys, 57 percent as opposed to 38 percent, suggests that larger plants are more likely to be connected to municipal facilities than are smaller plants. This conclusion was supported by the telephone discussions with the state pollution control officials.

In those instances where processing plants have tied in with municipal systems, there have been problems on occasion that necessitates investment in pretreatment facilities by the processor. Several state officials indicated that the characteristics of waste from several fruit or vegetable operations were such that the municipal system would malfunction without some form of pretreatment.

Therefore, even though a plant did not have to construct a completely self-sufficient system, a major investment in pretreatment facilities might be necessary. One state official cited a case where a $60,000 investment was necessary to reduce the load to discharge in the public system.

In one instance cited, where the small local municipal system could not handle the waste load of a large processing plant and where no nearby land was available for lagooning and spray irrigation, the plant installed an 8 inch pipe some 8 or more miles into the countryside to reach the spray fields. The alternative was to move or to close operations.

In one state some 30 fruit and vegetable processing plants had been under enforcement procedures by the state pollution control agency. During the past several years all except 5 have brought their operations into line with regulations. Some 20 of the 30 built their own facilities, while the remainder connected to municipal operations. These 30 plants had a waste treatment demand that was equivalent to 1.5 million people. Thus, in this particular state a great deal of progress and investment has been made toward bringing the fruit and vegetable operations to an acceptable level of compliance.

In another state eight new facilities for processing operations have been completed within the past 18 months. These facilities have an equivalent capacity of 850,000 people. Most of the industries in this state had gone with municipal connections. But again there were many small plants within this particular state that were not located near municipal operations and who were faced with major decisions regarding pollution abatement procedures.

In general, the survey of state officials suggests that fruit and vegetable processors may be about equally divided between municipal operations and some form of lagoon and spray irrigation operation. In any case the impact of future adjustments to pollution abatement costs will be felt throughout the nation. No single state indicated that all necessary investments had been accomplished. Also, it appears that, in all states, the smaller processors have further to go, and hence will be impacted more, than the larger firms.

Even though it is not now possible to develop a definitive and precise estimate of how far the fruit and vegetable industry has come in updating and modernizing its pollution abatement procedures, a general conclusion can be reached that enough remains to be done to warrant close analysis of expected dislocation effects.

IV. OVERALL IMPACT ON THE INDUSTRY

Because of the unique structure and competitiveness of the fruit and vegetable processing industry, pollution abatement facilities will have very serious consequences on the industry itself. Unless some lower cost pollution abatement alternative such as municipal treatment can be found the smaller third -- and to some extent the middle third -- of the plants will be seriously impacted. It is doubtful it will be able to recover the cost of installing and operating the abatement facilities and will most likely be forced to shut down. Little impact, however, will be felt by the ultimate consumer of the fruit and vegetable products.

A. Price Increases

Price increases required to cover the cost of pollution abatement facilities were calculated for individual plants and for various product configurations in Chapter III. To arrive at the overall impact of pollution abatement costs certain assumptions had to be made concerning the average increases in price required by the representative plants, the cost and percentage of plants using municipal treatment, and the extent to which the industry has already invested in abatement facilities.

For those plants that must provide their own facilities, the following may be considered representative:

Plant Grouping	Percent of Total Volume	Required Price Increase Low	Average	High
Large	80	3.9	5.5	7.5
Medium	15	4.6	6.4	8.1
Small	5	7.2	9.6	11.6
Weighted average increase required		4.8	5.8	7.8

According to The Cost of Clean Water, it is assumed that 65 percent of the waste water will be discharged to municipal sewers. Other studies and our own informal survey place the figure somewhat lower (see Chapter III, Section F). Assuming that 50 percent of the individual plants will use municipal facilities and that they will not be subsidized by local communities, but must pay the incremental cost as estimated in Chapter III, Section E, this will amount to the following:

Plant Grouping	Percent of Total Volume	Required Price Increase Low	Average	High
Large	80	1.6	2.5	3.1
Medium	15	2.4	3.1	3.9
Small	5	2.5	3.2	4.2
Weighted average increase required		1.8	2.6	3.3
Average plant and municipal treatment		3.3	4.2	5.5

According to information received from CEQ, 57.9 percent of the abatement technology is installed and is currently being paid for under present operating conditions and present price levels. Thus the overall price increase necessary to recover costs in pollution abatement facilities would amount to 1.8 percent with a range from 1.4 to 2.3 percent.

As a result, the medium sized plants and especially the small plants can not be expected to recover the costs expended for pollution abatement facilities if they can find no lower cost alternative to the abatement configuration presented by CEQ. Further, it is general information in the industry that many small and medium size plants are currently operating in a marginal position and would not be able to cover the abatement costs from their current profit levels. Larger plants appear to be in a stronger position. If the small and medium size firms would attempt to raise prices to the level where they could recover the costs of their pollution abatement facilities, they would be quickly undersold by the larger firm.

It should be remembered that the estimated level of capacity at which the industry is operating is approximately 75 percent or less. At that rate the large firms could quickly step up production to fill the void of the small and medium size plants that may be forced out of business. In fact the larger firms may be better off because they individually would be operating at a more profitable level as they expanded production.

An overall price increase of 1.4 to 2.3 percent at the wholesale level would have little impact in the consumption patterns of the consumer. In a study by Brandow of Pennsylvania State University [1/] the price elasticity for all fruits is identified as -.60 and for all vegetables at -.30.

[1/] Brandow, G. E., Interrelations Among Demands for Farm Products and Implications for Control of Market Supply, Bulletin No. 680, Pennsylvania State University 1961.

This means that a 1 percent increase in price will result in .6 percent and .3 percent decreases in consumption, respectively. Total per capital consumption of processed fruits is currently 67 pounds and is expected to climb to 70-75 pounds by 1980; total per capita consumption of processed vegetables is now 115 pounds with an expected growth to 120-130 pounds by 1980. Thus, if all costs are passed forward, a resultant decrease of 0.5 to 1.0 percent or approximately 1 to 2 pounds per capita could be expected. This would be less than the total annual increase in consumption resulting from population expansion and projected increases in per capita consumption.

Ability to Increase Prices Relative to Competition

Fresh Product Competition. Fresh fruits and vegetables pose little threat as substitutes for processed products. Because of convenience in preparation of processed commodities, they have been steadily gaining on fresh. With the relatively small expected rise in price for processed commodities this trend is not expected to be reversed. This is, of course, on an industry-wide basis.

There may be individual processed products where the overall price increase is greater than 1-2 percent because of unique processing characteristics. A greater impact could result from increased competition from the fresh products where higher processing costs would reduce the price differential between the fresh and processed forms of the same product.

Imports of Processed Fruits and Vegetables. The impact of increased imports of processed fruits and vegetables associated with anticipated increased costs of domestic processed products, is generally expected to be limited. With the exception of substantial imports of processed mushrooms and tomato products, imports of vegetables are negligible and would not be expected to increase materially. Apple juice, frozen strawberries, pineapple products and frozen blueberries are the principal fruit products imported. Production areas for pineapple and blueberries are limited in the United States and imports of tomato products from Italy and Spain is, in part, associated with style of pack. Frozen strawberries from Mexico are a major competitive item and increased costs could reduce the competitive position of U.S. frozen strawberries.

However, both U.S. producers of raw products and U.S. processors are large and highly mechanized as compared to foreign suppliers and in spite of increased costs of pollution abatement, it is probable that the overall increase of imports would be small.

Substitutes Among Processed Fruits and Vegetables. The possibility of substitution among processed products due to differential costs for pollution abatement is considered slight. Basically products which have a high degree of substitutability have similar levels of effluent. For example, the volume of waste water for peas is estimated at 16-86 gallons per case processed, while for green beans and corn it is 30-51 gallons and 29-80 gallons, respectively. In another case, apples, peaches and apricots all range from 30 to 90 gallons of waste water. The waste effluent from spinach is higher at 180 gallons per case--but other leafy green vegetables which are close substitutes, have similar effluent levels. Again minor exceptions may occur, but the problem would be slight.

B. Profitability of the Industry

Net income as a percent of equity fell sharply from 9.9 percent during the 1965-67 period to 4.6 percent during the 1968-70 period. These figures for a select group of firms were obtained from the National Canners Association and discussed fully in Part II, Chapter III. Although time for a select group (total industry figures are not available), this situation is generally considered to be true for the entire industry and reflects the impact of the recent cost-price squeeze. Because of the competitive nature of the industry product prices did not increase as rapidly as input prices .

There are no data available reflecting the relative profit margins for the small, medium and large firm. Small firms are generally considered to operate on a lower profit margin than larger firms and this, of course, is also reflected in our industry analysis. With pollution abatement standards imposed on the industry, profit margins will be further reduced because of the structure and competitive nature of the industry. In fact, the profitability of the small to medium sized - many of which are inefficient and under capitalized - will be very severely impacted. While the average incremental costs for pollution abatement are expected to be passed through to the consumer, the smaller firms are expected to have a much higher than average per unit cost of abatement. If the small to medium size firm cannot contract for the use of municipal systems or some other lower cost alternative, they cannot be expected to recover the investment in pollution abatement facilities - in short they will be forced to shut down. Even if they can contract with municipal facilities they will face additional costs which will further impact their profitability.

Economies of scale in pollution control are apparent, and this is naturally to the relative disadvantage of smaller firms. As previously suggested, many of the smaller firms will most likely be forced out of the industry. This would have a limited desirable impact on the remaining firms in that pollution control costs could be spread over a larger volume. Thus, the level of profitability of the surviving plants might be affected less on average.

Capital Availability. Capital within the fruit and vegetable industry is obtained primarily from commercial sources outside the industry. Additional capital requirements for financing pollution abatement measures will also principally be sought from such sources.

In this case, availability of additional capital is expected to be determined by an individual firm's ability to project adequate net returns following an expanded investment program. Consequently, capital availability is expected to be directly related to profitability--and the smaller, inefficient firms will have difficulty raising the needed capital to stay in business. When smaller firms are not able to present evidence that they can increase prices to offset the abatement costs--and when abatement financing requirements amount to 50 to 100 percent of their total capital investment--small firms will simply not be in a position to compete in commercial financial markets for capital necessary to install pollution abatement facilities. In this sense the lack of capital availability will contribute to the shutting-down of marginal processing firms. The larger more efficient plants in a position to recover a larger portion of their costs, will be in a much stronger position.

Investment and Capital Markets. Pollution abatement costs will generate a demand for investment capital directly. Total investments required for pollution abatement facilities in the fruit and vegetable industry have been estimated, by the Council on Environmental Quality, at about $289 million (current value). However, a large portion of this total requirement, namely $167 million (current replacement value) is estimated to be already invested. Thus, the difference of $122 million represents a preliminary estimate of additional investment capital which will be needed.

Little new construction of modern plants is expected, and thus little growth in demand for investment funds from this source is anticipated. A slight decline is expected in the demand for operating capital by those firms shut-down following controls. On balance, industry demands for investment funds from capital markets will essentially equal the cost of pollution abatement facilities.

C. Industry Dislocations

Differential impacts from pollution abatement controls are expected within the fruit and vegetable processing industry, both in terms of type of firm and in regional location of affected plants. The impacts expected and reasons for associated dislocations are as follows.

As explained earlier, the fruit and vegetable processing industry is comprised of many firms differing in process (canning, freezing), products processed (multi/single), size (rate per hour), length of season (long/short), capacity and utilization of capacity, level of technology (new/old) and other factors. These factors were considered in the industry analyses, and the most critical measure in terms of assessing a firm's ability to withstand the impact of internalized pollution abatement costs is its overall through-put size.

In order to represent types of firms in the industry, a series of plants were defined and referred to as being either small, medium or large. In all cases, these plants were reflective of through-put size or total volume packed.

Marginal Firms. Within the fruit and vegetable industry, marginal firms are typically the "small" firms as defined above and the older medium sized firms. This is particularly true in terms of a small firm's ability to financially withstand the projected high capital investment requirements of internalized pollution abatement measures. Such plants simply lack capacity to pay-out such investments (at the levels given).

Within this framework, marginal firms faced with the decision to either curtail employment or shut-down would most likely shut down. Pollution abatement investment costs would be an incentive to expand production, not lower it, in order to cover additional costs.

Because of rather wide-spread underutilization of total capacity in the industry, it is not expected generally that marginal firms will attempt to expand their existing facilities to achieve desired economics of scale; the competitive structure of the industry will influence outward migration of firms. As previously described in Part II, Chapter II, downward trends in the number of both canning and freezing plants is occurring and the pollution abatement controls are expected to hasten this downward trend of total firms in the industry. Total number of firms has decreased by approximately 25 percent in the past 10 years.

Because of the unique structure of the canning and freezing industry the capacity of the low cost-high volume processor relative to high cost - low volume processor is the single-most important factor in considering the impact of pollution abatement costs imposed on the industry. The industry is currently operating at about 75 percent of capacity. In the canning industry the largest-third of the plants pack approximately 80 percent of the total volume. The middle-third of the plants pack about 15 percent, and the smallest-third can only 5 percent of the total pack. With the economies of scale demonstrated earlier, the larger plants already have a definite cost advantage. The imposition of high pollution abatement costs on the smallest-third of the plants, and to a large extent the middle-third, will result in further diseconomies to the low volume plants. If the small plants are forced to shut down the low cost-high volume plants in the industry could easily offset possible losses in capacity among the high cost producers. On a theoretical basis this would be true, even if the smallest two-thirds of the industry were forced to shut down.

It is difficult to make broad generalization for the fruit and vegetable processing industry, but it appears evident that the smallest two-thirds of the plants are in very serious trouble if alternative lower cost sources of pollution abatement facilities cannot be found. If the high cost facilities are the only alternative, it is extremely doubtful if they could raise sufficient capital to install them and if they did, they would be unable to raise prices sufficiently to pay for them. The only logical alternative is the use of municipal facilities or relocation of the plant so low cost spray irrigation or lagooning could be possible. Even if 50 percent of the marginal plants could find low cost alternative means of pollution abatement, one-third of the industry or approximately 400 plants may still have to shut down.

Location. Many of the marginal processing plants likely to be affected adversely by pollution abatement controls are located in areas or regions of the country that are already relatively economically depressed. Processor, grower and associated businesses are generally a major component of local economic development in these areas; and, consequently, any appreciable impact on these businesses will also impact the entire local economy via indirect multiplier effects on area incomes, employment, sales, level of trade, etc. Such effects are likely to be far more consequential in aggregate than the direct impacts of pollution abatement on the industry itself. Specific locational effects are discussed in Chapter V.

Growth. Aggregate total demand growth will likely only be dampened as a consequence of pollution abatement costs and expected higher retail prices. Population growth is expected to quickly offset any short-run declines in per capita consumption.

As described above, it is believed that neither trend increases in per capita demands nor in total volumes of demand for processed fruits and vegetables will be seriously affected.

Growth in aggregate supply comensurate with demand, as projected, is naturally expected to occur. However, patterns of growth within the industry--in terms of location of processors and growth patterns among types of firms (large/small, etc.) are expected to change. Pollution abatement controls will largely tend to hasten downward trends in the number of plants operated and result in fewer but larger plants. Regional or area growth patterns are yet uncertain.

National Prices. The net impact of pollution controls on processed fruit and vegetable prices at the national level is expected to be moderately to slightly upward, e.g., 1-2%. Essentially all pollution abatement costs are expected to be passed forward to the consumer level as a first effect. This will likely occur because of the very competitive structure of the industry at the grower as well as the processor level.

A secondary impact, which may improve retail prices, however, is that of shifting of processing to larger, more efficient firms in the industry where economies of scale can be achieved. This is believed generally feasible in the present industry because of rather widespread under-utilization of capacity. However, more specific information on individual firms is necessary, before a conclusive judgement regarding this latter affect can be reached.

D. Employment Factors

Since many fruit and vegetable processing plants are located in relatively small urban centers and rural areas, the potential impact of dislocations may be born disproportionately by areas which already lag the nation in economic health. Approximately 90 percent of the employees of processing plants are relatively unskillled and only part-time employed. This large segment of the total labor force required is not generally mobil and would have difficulty relocating. The remaining 10 percent of management and higher-skilled production worker labor force would be more mobil, but many would not likely be needed or absorbed for some time by the remaining industry given current widespread underutilization of capacity in the industry.

The potential for individuals to shift from small plants that might be dislocated to larger plants is of limited significance. First, existing large plants are operating at less than full capacity and would not require significant expansion of labor force to take up the volume abandoned by small plants. Secondly, the larger plants are more efficient from the labor standpoint and require less labor to produce a given output.

For example, the Sweet potato canning plants analyzed in this report had a production worker labor force of 55 people for the small (80 cases per hour), 90 for the medium (280 cases per hour), and 190 for the large (760 cases per hour). A major portion (50 to 75 percent) of this labor force is employed on the firm tables, a very low skill job. In terms of output per hour of production worker labor the results are as follows: Small plant - 1.45, medium - 3.11, and large - 4.00.

Thus, it is evident that a large plant can take up the production slack of departing small plants with fewer additional production workers than were dismissed by the small plants.

It is significant to remember that, in 1967, 40 percent of the total canned and frozen fruit and vegetable plants in the United States employed less than 20 people. For canned specialties, 52 percent of the plants fell into the category of fewer than 20 employees, while the pickle industry had 65 percent of its plants in this category.

Due to the seasonal nature of the canning and freezing industry, a great many production line workers are female and use the seasonal employment to supplement the family income. This is especially true for those jobs relating to trimming, peeling and visual inspection of the product. These jobs are almost entirely filled by female employees.

Therefore, any job dislocation will, while not removing the prime source of family income, definitely affect the economic wellbeing of many people. If 400 small and medium size plants were forced to shut down, this would directly result in the loss of jobs by 28,000 employees.

E. Raw Product Suppliers

The impact of economic dislocations in the canning and freezing industries will also be felt very strongly by raw product producers. The industry, as pointed out earlier, is supply oriented. The locational pattern of processing plants is directly linked to the raw product production pattern. A majority of the processing firms procure their raw product supplies from an area within 50 miles of the plant.

Therefore the income opportunity for farmers within a given area can be significantly altered by changes in the locational pattern of processing plants. Even though a single plant does not require a huge acreage to support its operation, the farmers can use processing crops as a supplemental enterprise with a minimum of effort. The processor usually contracts for a specific acreage prior to planting and provides much of the specialized production and harvesting equipment. The individual farmer needs a minimum investment and has a relatively low risk operation.

Regarding acreage requirements to support a processing plant, the sweet potato plants used in this analysis would, for the assumed annual output, require the following acreages of raw product: small-70, medium -350, and large - 1270.

In most instances the small processor probably buys raw product from the smaller farmers. This is particularly true for such products as sweet potatoes, tomatoes, leafy greens, carrots, and corn. Larger processors need to contract for larger blocks of acreage to achieve economies in production and harvesting operations. The cost of moving large harvesting equipment from one small plot to another provides a strong incentive to search for growers with larger blocks of land available. Thus, again the indication is strong that a disproportionate amount of any dislocation may rest on the small farmer.

Another possible impact of suppliers of input, mainly growers, would be to "pass-back" added costs for pollution abatement. However, due to almost complete mechanization of grower operations, including harvesting, and steadily rising production costs (labor, fertilizer, seed, pesticides, etc.) it does not seem that farm-level grower prices can be lowered to pass-back the anticipated pollution abatement costs. A cost-price squeeze is already paramount at the farm level.

F. Effects on Other Suppliers and Consumer Industries

Two types of industries are directly affected by changes in the fruit and vegetable processing industry: Suppliers of input, and customers of packed output. These industries are briefly described and possible impacts discussed.

Both suppliers of inputs, other than raw product growers, and wholesale-retail customers can be expected to be affected by pollution controls on the fruit and vegetable processing industry.

Supplier Impacts. Suppliers of inputs will be affected mostly on an area by-area basis due to expected plant dislocations rather than in aggregate. This follows in that industry-wide supply requirements, while perhaps depressed in the short-run, will soon return to and exceed previous levels. On the other hand, area-by-area dislocations will probably be long term.

Most input suppliers, such as container and other ingredient suppliers, may adjust relatively easily both to aggregate changes in requirements in the short run and area-by-area distribution requirements.

Customer Impacts. Wholesale-retail customers will be affected, but probably only in relatively minor ways. Price changes will likely be widespread, but adjusted for readily. Supply sources might change, but again this may not be a major factor for the customer industries.

Wholesale and retail customer industries have typically maintained constant or "sticky" margins for fruit and vegetable products marketed. Hence, any price increases are expected to be paseed through to the consumer level with a consequent lower aggregate volume of products demanded. Differential impacts might be expected among various fruit and vegetable products, due to possible differences in pollution control costs among products, but as indicated above, this aspect is believed to be of relatively minor importance.

Wholesale and retail customers can expect higher prices for products with consequent higher retail prices to final consumers. Given probable "pass-through" of prices, the net affect on the customer industries is expected to be relatively minor.

The elasticities of aggregate demand for fruit has been estimated at (-.6) and for vegetables at (-.3), an overall expected price increase of 1.4 to 2.3 and the generally inelastic nature of demands for fruits and vegetables, plus normal growth in demand, suggest that total volume of demand will not decrease drastically given the expected increase in price. A possible decrease of 1 to 2 pounds per capita can be expected.

G. International Trade

Imports of Processed Fruits and Vegetables. The impact of increased imports of processed fruits and vegetables associated with anticipated increased costs of domestic processed products, is generally expected to be limited. With the exception of substantial imports of processed mushrooms and tomato products, imports of vegetables are negligible and would not be expected to increase materially. Apple juice, frozen strawberries, pineapple products and frozen blueberries are the principal fruit products imported. Production areas for pineapple and blueberries are limited in the United States and imports of tomato products from Italy and Span is, in part, associated with style of pack. Frozen strawberries from Mexico are a major competitive item and increased costs could reduce the competitive position of U.S. frozen strawberries.

However, both U.S. producers of raw products and U.S. processors are large and highly mechanized as compared to foreign suppliers and in spite of increased costs of pollution abatement, it is probable that the overall increase of imports would be small.

Balance of Payments. The overall tendency of pollution abatement controls in the fruit and vegetable processing industry, because of relatively higher domestic prices, will be toward an adverse balance of payments: export sales volume will tend to be less, while import purchases will tend to be higher. However, loss in sales volume will be partially off-set in terms of balance of payments via higher prices. The net impact will not likely be substantial, however.

Exports are significant for selected products and higher processing costs will affect the U.S. competitive position in foreign markets. If sales are reduced, a deterioration of U.S. balance of payments will result. The extent of this deterioration will depend on how effectively the particular segment of the industry can control pollution at a minimum cost.

V. SPECIFIC REGION/AREA AND ECONOMIC DISLOCATION IMPACTS

Differential area impacts are expected within the fruit and vegetable canning and freezing industries if pollution control standards are uniformly imposed on all processing plants. As described above, the 'small' plants are expected to be most severely impacted, and these plants are not uniformly distributed throughout the main processing regions/areas of the United States.

A. Procedures for Assessing Differential Impacts

On the premise that small, and to some extent medium, sized plants are to be impacted most severely, an intensive effort was made to identify each plant in the industry and to obtain a number of key characteristics about each plant, particularly size and location.[1] This information was coded and processed for use in a cross-tabulation analysis program.

The following data were developed for each of 1188 canners, freezers or combination canner/freezers:

Variable	Description
(1)	Census Region Location
(2)	State Location
(3)	County Location
(4)	Economic Region Location[2]
(5)	Economic Subregion Location
(6)	Economic Development Administration Qualified County (1 = yes; 2 = no)
(7)	Type of Plant (1 = Canner; 2 = Freezer; 3 = Both)
(8)	Size Class (1 = Small; 2 = Medium; 3 = Large)[3]
(9)	Type of Products Packed (1 = fruit; 2 = vegetables; 3 = both)
(10)	Number of Products Packed (actual)
(11)	Number of Plants in Firm (actual)

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[1] The Directory of the Canning, Freezing, Preserving Industries, 1970-71 Third Biennial Edition, Compiled and Published by Edward E. Judge & Sons, Maryland, 1970.

[2] Bogue, Donald J. and Calvin L. Beale, Economic Areas of the United States, The Free Press of Glencoe, Inc., April 1961.

[3] An initial 9 code classification (described in the Appendix) was recategorized following preliminary analysis to approximate one-third in each class.

The cross-tabulations of primary concern are the size-of-plant/location analyses.

A sample page of one computer-generated table is shown in Exhibit V-1. A complete reference document is available as Part IV: Statistical Supplement of this study.

Two basic types of "location" tables were generated:

(1) Census Region
  State
    County
(2) Economic Region
  Economic Subregion

The 'Census Region' series is primarily described herein because census regions are most familiar. However, the 'Economic Region' series has an advantage of keeping "economically contiquous areas" together irrespective of state boundaries. Should further analyses be made, it is recommended that the 'Economic Region' series be referred to in addition to the 'Census Region' series.

Variables (6) to (11) above were "cross-tabulated" with these two location types. Two runs were necessary to obtain all the desired cross-tabulations; and, variables (10) and (11) are contained on the second run which is available in Part IV.

Based on the judgement of knowledgeable persons in the industry, it is believed that 90-95 percent of the processing plants in the canning and freezing industries are contained in the source cited above (The Directory) and thus, the sample data is nearly a complete enumeration of the study population. As explained in the Appendix, it was necessary to subjectively code some "missing data"; namely (1) plants without a size-code were included as small plants, (2) multi-plant firms with more than five plants (and only a firm size code) were included as large, and (3) multi-plant firms with five or less plants were given a size code based on a computed average.

The plants included in this study are only those within the continental United States. Numerous plants exist in Hawaii, and further analysis is required concerning these plants.

Exhibit V-1

P-585 CEQ STUDY CROSS-TAB ANALYSIS
PLANT DATA -- CENSUS REGION, STATE, COUNTY
ALL PLANTS

STATE AND COUNTY	CODE	TOTAL NO. PLANTS	EDA CO.PL.		TYPE OF PLANT			PLANT SIZE CLASS			PERCENT BY SIZE			TYPE OF PRODUCTS		
			NO.	PCT.	CAN	FREEZE	BOTH	SMALL	MED.	LARGE	SMALL	MED.	LARGE	VEG.	FRUIT	BOTH
								SOUTH ATLANTIC REGION								
DELAWARE																
KENT	22 1	4	0	0	3	0	1	3	0	1	75	0	25	4	0	0
NEW CASTLE	22 2	3	0	0	3	0	0	2	1	0	67	33	0	3	0	0
SUSSEX	22 3	10	10	100	4	2	4	6	4	0	60	40	0	9	0	1
STATE TOTAL		17	10	59	10	2	5	11	5	1	65	29	6	16	0	1
MARYLAND																
BALTIMORE	23 3	5	0	0	4	0	1	2	2	1	40	40	20	3	2	0
CAROLINE	23 6	5	0	0	4	1	0	3	2	0	60	40	0	5	0	0
CARROLL	23 7	4	0	0	4	0	0	4	0	0	100	0	0	4	0	0
CECIL	23 8	1	0	0	1	0	0	0	0	1	0	0	100	1	0	0
DORCHESTER	23 10	10	10	100	10	0	0	9	0	1	90	0	10	9	0	1
FREDERICK	23 11	1	0	0	1	0	0	1	0	0	100	0	0	1	0	0
HARFORD	23 13	4	0	0	3	1	0	3	1	0	75	25	0	4	0	0
KENT	23 15	1	0	0	1	0	0	1	0	0	100	0	0	1	0	0
PRINCE GEORGES	23 17	1	0	0	1	0	0	1	0	0	100	0	0	1	0	0
QUEEN ANNES	23 18	2	0	0	2	0	0	0	2	0	0	100	0	2	0	0
SOMERSET	23 20	3	3	100	3	0	0	2	1	0	67	33	0	3	0	0
TALBOT	23 21	7	0	0	6	1	0	2	5	0	29	71	0	7	0	0
WICOMICO	23 23	2	0	0	2	0	0	1	0	1	50	0	50	2	0	0
WORCESTER	23 24	7	0	0	7	0	0	6	1	0	86	14	0	7	0	0
STATE TOTAL		53	13	25	49	3	1	35	14	4	66	26	8	50	2	1
VIRGINIA																
ACCOMAC	24 1	3	0	0	3	0	0	1	2	0	33	67	0	3	0	0
BEDFORD	24 10	1	0	0	1	0	0	1	0	0	100	0	0	1	0	0
CAROLINE	24 17	1	0	0	1	0	0	1	0	0	100	0	0	1	0	0
CLARKE	24 22	1	0	0	1	0	0	0	1	0	0	100	0	0	1	0
CULPEPPER	24 24	1	0	0	1	0	0	0	1	0	0	100	0	0	1	0
FAIRFAX	24 29	1	0	0	1	0	0	1	0	0	100	0	0	1	0	0
FLUVANNA	24 32	2	0	0	2	0	0	0	1	1	0	50	50	0	2	0
FREDERICK	24 34	1	0	0	1	0	0	1	0	0	100	0	0	0	0	1
HIGHLAND	24 45	1	1	100	1	0	0	1	0	0	100	0	0	1	0	0
ISLE OF WIGHT	24 46	1	0	0	1	0	0	0	1	0	0	100	0	0	0	1
KING GEORGE	24 49	1	0	0	1	0	0	1	0	0	100	0	0	1	0	0
NORTHAMPTON	24 65	4	0	0	3	1	0	4	0	0	100	0	0	4	0	0
NORTHUMBERLAND	24 66	1	1	100	1	0	0	1	0	0	100	0	0	1	0	0
PAGE	24 69	2	0	0	2	0	0	2	0	0	100	0	0	1	1	0

B. Region Analysis

On an operating plant basis, the fruit and vegetable canning and freezing industries are dispersed throughout every major region of the Continental United States, and within 43 of the 48 states. However, concentrations do exist both on regional and state bases such that differential economic impacts are expected among various geographic areas.

A total of 1188 plants are included in this analysis--841 canners, 176 freezers and 171 combination canner/freezers. These plants are distributed among the nine census regions as shown in Table V-2.[1] The largest concentrations of all plants are in the Pacific, East North Central, South Atlantic, and Middle Atlantic Regions.

As mentioned above, the focus of analysis is intended to be the proportion of 'small' plants within an area (region, state, etc.) relative to the total number of plants. This emphasis follows from the expected severe impact of pollution abatement costs on small plants relative to larger plants. The percentages by size class for each major region are also shown in Table V-2. The regions with the highest percentages of small plants are: (1) New England, (2) South Atlantic, and (3) Middle Atlantic. Note, however, that New England has much fewer total plants.

Another way of summarizing the same information is as shown in Exhibit V-2. The bar-chart readily shows the distribution of small-medium-large plants within each region and interregional comparisons can be made quickly. An interesting phenomenon is the wide variability in the percentages of both 'small' and 'large' plants, but a fairly narrow range for 'medium' plants:

Size Class	Range of %'s	U.S. Average
Small	20-53	36
Medium	24-34	29
Large	9-51	34

On a regional basis, four of the nine census regions have an "above U.S. average" percentage of small plants:

New England
South Atlantic
Middle Atlantic
Mountain

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[1] Table II-1 not included.

Table V-2. Number, Type and Size Distributions of All Canning and Freezing Plants, by Census Region, 1970

Census Region	All Plants							
	Totals		Number by Type Plant			Percent by Size		
	No.	Pct.	Canner	Freezer	Both	Small	Medium	Large
New England	32	3	19	9	4	53	34	9
Middle Atlantic	179	15	121	28	30	42	30	27
E. North Central	278	23	221	17	40	35	28	37
W. North Central	45	4	41	2	2	24	24	51
S. Atlantic	205	17	152	25	28	52	30	18
E. South Central	25	2	18	6	1	20	32	48
W. South Central	81	7	70	4	7	32	31	37
Mountain	49	4	33	8	8	39	27	33
Pacific	294	25	166	77	51	26	30	44
Total U.S.	1188	100	841	176	171	36	29	34

Source: Agri Division, Dunlap and Associates, Inc.

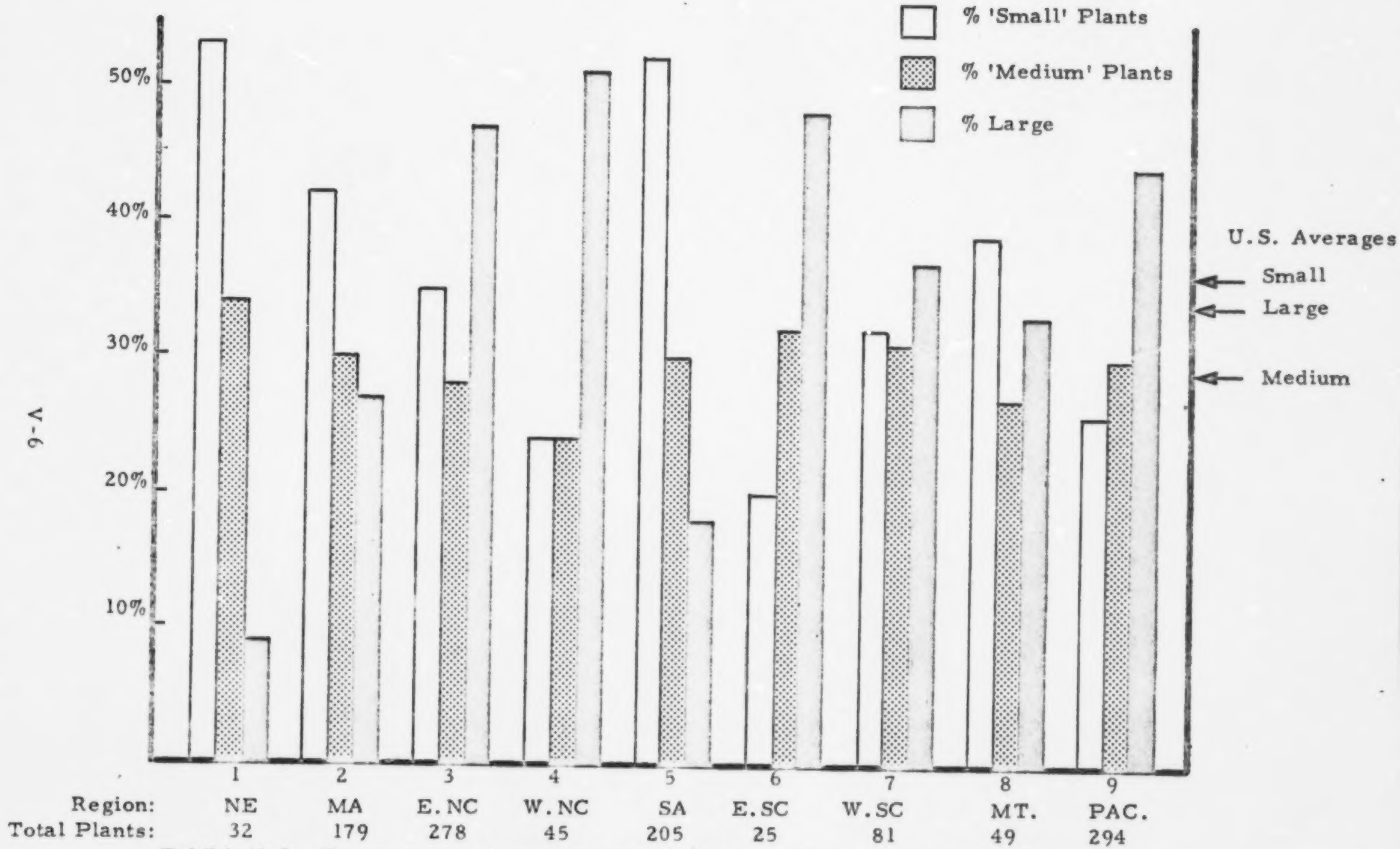

Exhibit V-2. Percentages of 'Small', 'Medium' and 'Large,' Canning and Freezing Plants by U.S. Census Region, 1970.

In order to get a feel for the broad areas which are expected to be impacted relatively hard (and perhaps differentially), it is instructive to see these regions portrayed in relation to the total U.S. as shown in Exhibit V- 3. The four regions cited are shaded. (Two additional states, Ohio and Michigan, are also shown because they have an 'above average' percentages of small plants and a substantial number of small plants.)

Besides the 'relative' number of small plants, it is also important to consider the absolute numbers involved. Both the South Atlantic and the Middle Atlantic are consequently of greater concern on a regional basis.

Thus far, emphasis has been on overall plant distributions. However, tabulations were also made for type of plant, as summarized in Table V- 3. Briefly, the regions having the greatest proportions of small plants by type of plant are:

Canners Only	Freezers Only	Combination Canner/Freezers
S. Atlantic	New England	Mountain
New England	Middle Atlantic	Middle Atlantic
Mountain	E. North Central	New England

To a large extent the waste treatment requirements and problems are quite similar whether the processing plant is a canning or feeezing operation. Also, the size classes used herein were developed independently and similarly (approximate thirds) for the three types. Therefore, it is believed meaningful to group all three types in subsequent discussion even though some differences do exist in area location of concentrations of small plants.

Before proceeding to less-aggregate locational analyses, it is meaningful to briefly consider associated regional results. Distributions of plants among 'Types of Firms' and 'Number of Products' packed on a regional basis appear to 'explain,' in part, the concentration of small plant patterns thus far obtained. (See Table V- 4). That is, single plant firms and single product firms are also heavily concentrated in the same regions as are small plants. (Further analysis, e.g. Chi square, could be used to confirm this, but time was not available in this study.) For comparison the main concentrations of these type plants are in the following regions:

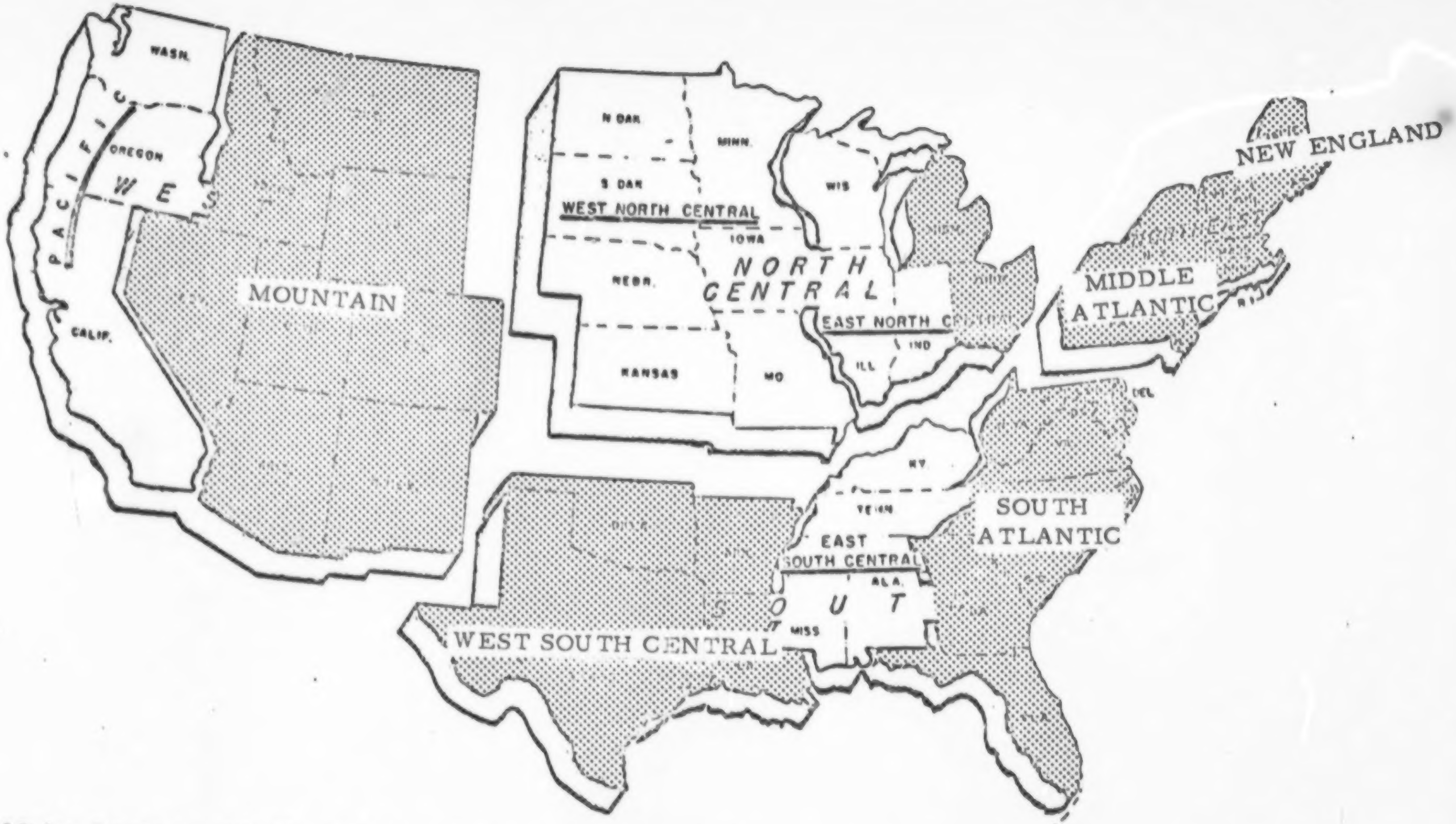
WASH.
OREGON
CALIF.
PACIFIC
WEST
MOUNTAIN
N DAK
MINN.
S DAK
WEST NORTH CENTRAL
IOWA
NEBR.
KANSAS
MO
NORTH CENTRAL
WIS
EAST NORTH CENTRAL
ILL
IND
NEW ENGLAND
MIDDLE ATLANTIC
R.I.
DEL
KY.
TENN
EAST SOUTH CENTRAL
ALA.
MISS
SOUTH
SOUTH ATLANTIC
WEST SOUTH CENTRAL

Exhibit V-3. Major Regions with Above U.S. Average Percentage of 'Small' Canning and Freezing Plants, (Plus Other States with More than 5 'Small' Plants and Above Average Percentage of Small Plants), 1970

Table V-3. Percent Distribution of Canning, Freezing and Combination Canning-Freezing Plants by Size, by Census Region, 1970

	Canners Only				Freezers Only				Combination Canners/Freeze			
	Total No. Plants	Percent by Size			Total No. Plants	Percent by Size			Total No. Plants	Percent by Size		
Census Region		Small	Med.	Large		Small	Med.	Large		Small	Med.	Large
New England	19	44	44	12	9	78	22	0	4	50	25	25
Middle Atlantic	121	35	35	31	28	64	21	0	30	54	22	24
E. North Central	221	33	26	41	17	59	35	6	40	33	36	31
W. North Central	41	24	27	49	2	0	0	100	2	50	0	50
S. Atlantic	152	59	26	15	25	36	40	24	28	32	43	25
E. South Central	18	22	33	44	6	17	17	67	1	0	100	0
W. South Central	70	31	31	37	4	25	25	50	7	43	29	29
Mountain	33	42	30	27	8	13	25	63	8	56	15	29
Pacific	166	25	30	45	77	25	30	45	51	28	33	39
Total U.S.	841	36	29	34	176	38	29	34	171	36	31	30

Source: Agri Division, Dunlap and Associates, Inc.

Table V-4. Distributions of All Canning and Freezing Plants Among Types of Firms (Firm Structure) and Among Number of Products Groupings, by Census Region, 1970

Census Region	Total No. Plants	Percent by Type Firm			Percent by No. Products		
		1 Plant	2-5 Plants	Over 5 Plants	1 Product	2-5 Products	Over 5 Products
New England	32	84	16	0	53	47	0
Middle Atlantic	179	65	23	12	40	51	9
E. North Central	278	54	23	23	24	73	3
W. North Central	45	49	7	44	40	51	9
S. Atlantic	205	78	14	8	34	60	6
E. South Central	25	56	32	12	24	60	16
W. South Central	81	59	16	25	24	59	17
Mountain	49	53	27	20	29	61	10
Pacific	294	50	28	22	22	63	15
Total U.S.	1188	60	22	18	29	62	9

Source: Agri Division, Dunlap and Associates, Inc.

Regions with High Concentrations

Single Plant Firms	Single Product Firms
New England	New England
S. Atlantic	Middle Atlantic
Middle Atlantic	W. North Central

Another type of consideration which can be summarized on a regional basis (and which is also considered subsequently) is the relationship of small plant county locations and whether the associated counties are "Economic Development Administration (EDA) Qualified" Counties. [1] One hypothesis was that small plants might be more heavily concentrated in EDA qualified counties -- and, if so, a greater economic burden could be expected as a result of any such plant dislocations.

Summary data on a census region basis concerning EDA - Small Plant concentrations are shown in Table V- 5. There is a slight relationship as hypothesized:

U.S. Averages

24% of all counties studied are EDA qualified
28% of total plants studied are in EDA counties
31% of small plants studied are in EDA counties

As shown in the table, the regions having the greatest differentials between the percent total plants and the percent small plants are as follows:

Region	% Total EDA	% Small EDA
West S. Central	28	47
S. Atlantic	33	40
Mountain	27	36
W. North Central	7	29

---

[1] See Section C below for further discussion of EDA qualified counties in relation to expected dislocations. EDA qualified counties are generally regarded as economically depressed areas which are eligible for various forms of assistance from EDA. Criteria for qualification are outlined in Qualified Areas...Criteria and Data, under the Public Works and Economic Development Act of 1965, PL 89-136, U.S. Dept. Commerce EDA, December, 1970.

Table V-5. Plant and County Statistics in Total and for Economic Development Administration (EDA) Qualified Counties, by Census Region, 1970

Census Region	Total No. Plants	Total No. Counties W/Plants	Ave. No. Plants Per Co.	% EDA Co's.	% Tot. Pl. in EDA Co.	% 'Small' Pl. in EDA Co.
New England	32	17	1.9	47	41	42
Middle Atlantic	179	58	3.1	10	11	12
E. North Central	278	138	2.0	14	17	14
W. North Central	45	36	1.3	8	7	29
S. Atlantic	205	95	2.2	26	33	40
E. South Central	25	22	1.1	32	28	0
W. South Central	81	41	2.0	34	28	47
Mountain	49	9	5.4	44	27	36
Pacific	294	62	4.7	47	47	46
Total U. S.	1188	478	2.5	24	28	31

Source: Agri Division, Dunlap and Associates, Inc.

To summarize the main region-analysis findings, the percentages of 'Small' canning and freezing plants both in total and in EDA qualified counties only are depicted in Exhibit V-4. Relative relationships among regions are stressed as has been discussed above for Total 'Small' plants. The relative regional relationships for EDA-Small plants are also shown, however. Note particularly that the West South Central and the Pacific Regions have above U.S. average percentages of small plants in EDA counties even though they are below average in percent of Total 'Small' plants.

A second set of region-level tables were generated for 'Economic Regions' as described in Section A, above. Given the time-schedule for completion of this study, it was not possible to summarize these findings as desired. However, two notes are: (1) Table V-6 is included to illustrate the type of results obtained, and (2) a complete set of Economic Region-Subregion tables is contained in the Part IV: Statistical Supplement portion of this report.

As anticipated, not all the detailed analyses desired could be completed; however, requisite findings for various additional analyses which CEQ might wish to complete are provided.

C. Subregion/Local Analysis

A logical procedure for further evaluation of locational impacts is to continuously reduce the level of geographic aggregation. Special attention can be focused on those broad (region) areas which have apparent severe problems.

In this study the Census Regions are comprised of two less-aggregate geographic units: States and Counties. (The Economic Region analysis is comprised of Subregions, i.e., 13 regions and 119 subregions in the continental U.S.) Attention is now placed primarily on the State-County findings.

In Table V-7, total plants and their size distribution by state are presented. From this summary, individual states with above U.S. average levels of small plants are readily seen. Note particularly states within selected regions, e.g., in the South Atlantic Region, the states of South Carolina, Maryland, Delaware, Virginia, Georgia and W. Virginia all have extremely high concentrations of 'small' plants.

In Exhibit V-5, the states with above U.S. average percentage of 'Small' plants are indicated on a U.S. map. This exhibit more precisely identifies

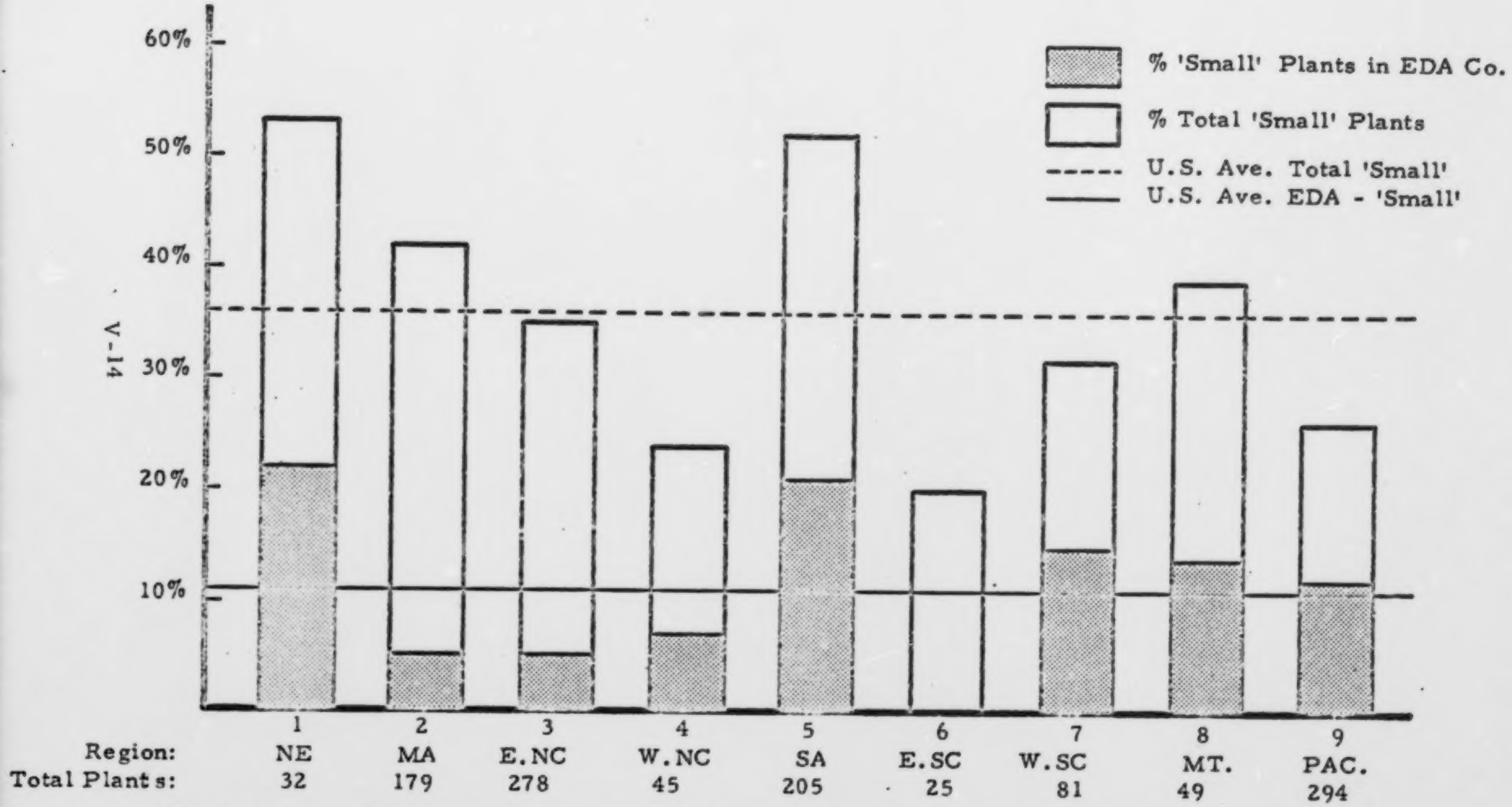

Exhibit V-4. Percentages of 'Small' Canning and Freezing Plants in Total and in EDA Qualified Counties Only, by U.S. Census Region, 1970

Table V-6. Total Plants and Size Distribution of All Canning and Freezing Plants, by Economic Regions, 1970

Economic Region	Total No. Plants	Percent by Size Small	Medium	Large	Percent of Total Plants in EDA Counties
Atlantic Metropolitan	174	52	30	18	25
E. Gr. Lakes & NE Uplds.	115	52	28	20	16
Lower Great Lakes	96	38	34	28	24
Upper Great Lakes	110	28	27	45	15
N. Center (Corn Belt)	112	32	24	44	4
Central Plains	16	31	44	25	0
C.& E. Upland	66	39	26	35	33
S.E. Coastal Plain	47	42	30	28	36
G. Coast & Atl. Flatwds.	96	32	39	29	34
S.C. and S.W. Plains	23	30	22	48	13
Rocky Mt. & Intermt.	37	41	18	41	30
Pacific Northwest	122	25	32	43	55
Pacific Southwest	174	26	30	44	41
Total U. S.	1,188	36	30	34	28

Table V-7. Total Plants and Size Distribution of All Plants, by State, 1970

Census Region & State	Total No. Plants	Percent by Size			Percent of Total Plants in EDA Counties
		Small	Medium	Large	
New England					
Maine	19	68	32	--	37
New Hampshire	1	--	100	--	--
Vermont	--	--	--	--	--
Massachusetts	12	33	42	25	50
Rhode Island	--	--	--	--	--
Connecticut	--	--	--	--	--
Reg. Total	32	53	38	9	41
Middle Atlantic					
New York	97	50	25	25	8
New Jersey	28	36	32	32	39
Pennsylvania	55	35	38	27	4
Reg. Total	179	43	30	27	11
E. North Central					
Ohio	42	47	29	24	5
Indiana	43	32	21	47	12
Illinois	23	26	26	48	--
Michigan	78	41	31	28	37
Wisconsin	92	28	28	44	11
Reg. Total	273	35	28	37	17
W. North Central					
Minnesota	27	15	22	63	4
Iowa	9	23	44	33	--
Missouri	6	67	--	33	33
North Dakota	--	--	--	--	--
Nebraska	1	100	--	--	--
Kansas	2	--	50	50	--
Reg. Total	45	24	24	52	7

(continued)

Table V-7. Total Plants and Size Distribution of All Plants, by State, 1970 (continued)

Census Region & State	Total No. Plants	Percent by Size			Percent Total Plants in EDA Counties
		Small	Medium	Large	
South Atlantic					
Delaware	17	65	29	6	59
Maryland	53	66	26	8	25
Virginia	28	64	29	7	21
W. Virginia	5	60	--	40	40
North Carolina	16	25	56	19	38
South Carolina	6	83	17	--	--
Georgia	16	63	12	25	56
Florida	63	32	36	32	33
Reg. Total	205	52	30	18	67
E. South Central					
Kentucky	6	33	33	33	--
Tennessee	12	8	25	67	33
Alabama	4	50	--	50	25
Mississippi	3	--	100	--	67
Reg. Total	25	20	32	48	28
W. South Central					
Arkansas	18	22	33	45	28
Louisiana	15	40	40	20	47
Oklahoma	11	64	9	27	64
Texas	37	24	33	44	11
Reg. Total	81	32	31	37	28
Mountain					
Montana	2	50	--	50	--
Idaho	20	25	25	50	35
Wyoming	1	100	--	--	--
Colorado	13	23	62	15	--
New Mexico	1	--	--	100	100
Arizona	3	67	33	--	67
Utah	9	78	--	22	33
Nevada	--	--	--	--	--
Reg. Total	49	39	28	33	27
Pacific					
Washington	70	20	30	50	77
Oregon	52	33	32	35	25
California	172	26	30	44	41
Reg. Total	294	26	30	44	47
Total U. S.	1,188	36	30	34	28

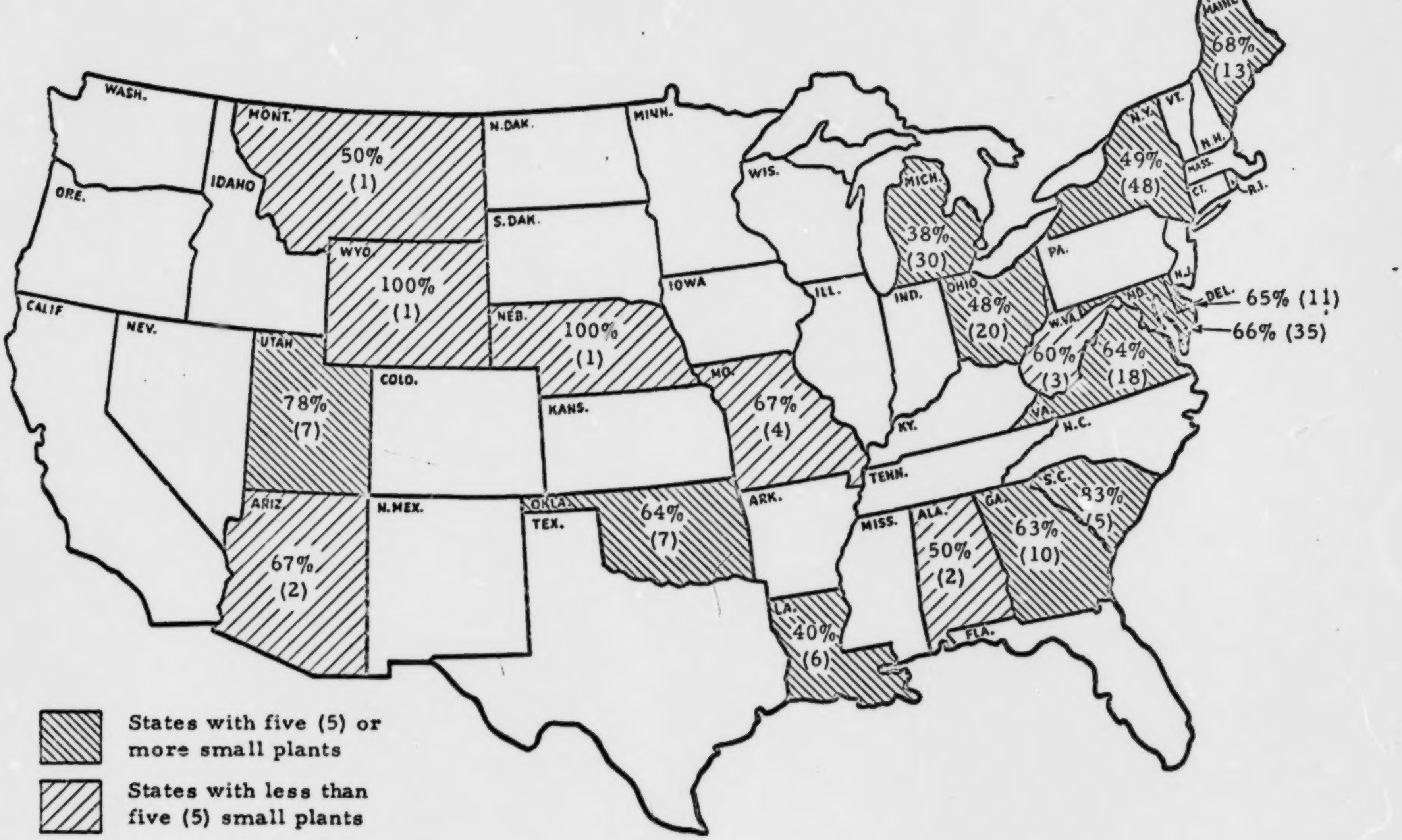
WASH.
ORE.
CALIF.
NEV.
IDAHO
MONT. 50% (1)
WYO. 100% (1)
UTAH 78% (7)
ARIZ. 67% (2)
COLO.
N.MEX.
N.DAK.
S.DAK.
NEB. 100% (1)
KANS.
OKLA. 64% (7)
TEX.
MINN.
IOWA
MO. 67% (4)
ARK.
LA. 40% (6)
WIS.
ILL.
MICH. 38% (30)
IND.
OHIO 48% (20)
KY.
TENN.
MISS.
ALA. 50% (2)
GA. 63% (10)
FLA.
S.C. 83% (5)
N.C.
VA. 64% (18)
W.VA. 60% (3)
MD.
DEL.
65% (11)
66% (35)
PA.
N.J.
N.Y. 49% (48)
VT.
N.H.
MASS.
CT.
R.I.
MAINE 68% (13)
▧ States with five (5) or more small plants
▨ States with less than five (5) small plants

Exhibit V-5. States with Above U.S. Average Percentage of 'Small' Canning and Freezing Plants. 1970

probable 'problem areas' within the U.S. Again it is stressed that these measures are relative. Later it is shown that other states have numerous small plants, but they also have many larger plants which compensate for the small ones. Nevertheless, key problem areas are generally expected in the East and South, plus, to a lesser absolute sense, in the Rocky Mountain area.

In order to further summarize 'small' plant statistics on an even less-aggregate basis, i.e., county level, it is expedient to consider sub-classes of counties. A key initial summary is an analysis of "only counties with two or more 'small' plants." County and plant data for this selection is summarized in Table V-8.

A sample of 78 counties from the 478 total counties studied are involved in this analysis. This number represents only 16 percent of the counties, but they contain about 60 percent of the total number of small plants in the U.S. Thus, any associated geographic concentrations of these counties would appear significant in terms of probable subregional/local economic dislocation impact.

A detailed enumeration of these 78 counties is presented in Appendix Table A-15. Associated data regarding total number of plants by size, type of plant (canner, freezer, both) and type of products packed (vegetable, fruit, both) are included. Also, the EDA qualified counties are noted.

This county-level information is also displayed on the map shown in Exhibit V-6. Here, some of the "absolute" vs. "relative" impacts can be ascertained, and the approximate actual locations of probable impact determined. Special note is made of those areas, particularly in the West and North Central states, which will be impacted even though the affected plants are relatively few in comparison to total plants in their respective areas. Note again the distinction of EDA vs. Non-EDA counties. More adverse associated economic dislocations are projected for 'small' plants in EDA counties which are likely to be shutdown.

Table V-8. County and Plant Data for Selected Counties (Two or More 'Small' Plants), by Census Region. 1970

Census Region	Only Counties with Two or More 'Small' Plants					Associated EDA Percentages		
	Total No. Counties	Total No. Plants	Number by Size			EDA Counties	Total EDA Plants	'Small' EDA Plants
			Small	Medium	Large			
New England	3	13	11	2	0	67	54	45
Middle Atlantic	12	99	55	26	18	17	17	15
E. North Central	17	86	50	21	15	18	16	14
W. North Central	--	--	--	--	--	--	--	--
S. Atlantic	21	112	70	29	13	29	40	40
E. South Central	--	--	--	--	--	--	--	--
W. South Central	4	18	9	8	1	50	33	44
Mountain	4	12	9	3	0	50	42	44
Pacific	17	160	54	39	67	53	46	46
Subtotal U.S.	78	500	258	128	114	33	33	31
All U.S. Totals	478	1188	428	356	404	25	28	30

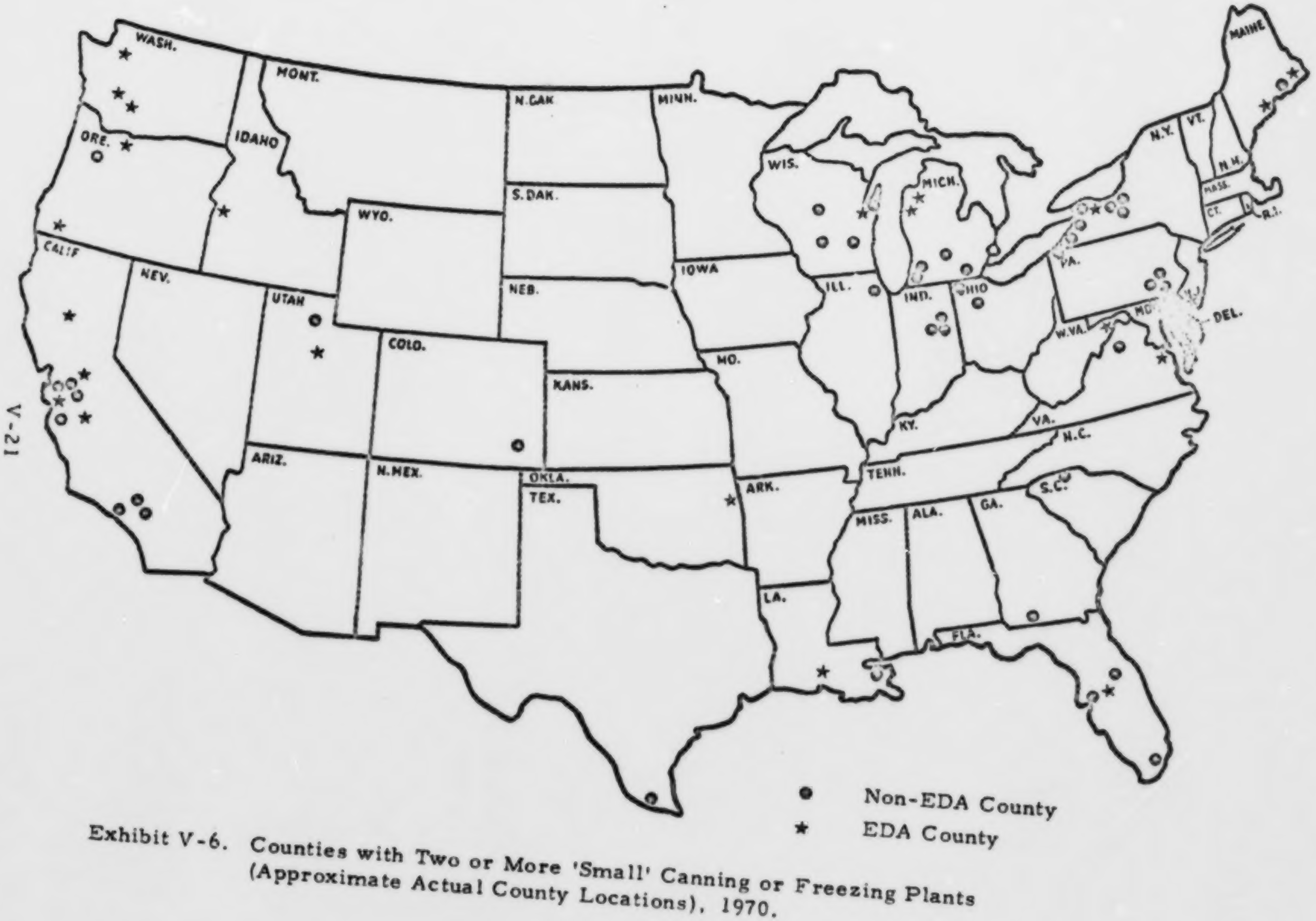
WASH.
MONT.
N.DAK.
MINN.
ORE.
IDAHO
WIS.
MICH.
N.Y.
VT.
N.H.
MAINE
MASS.
CT.
R.I.
S.DAK.
WYO.
CALIF
NEV.
IOWA
PA.
UTAH
NEB.
ILL.
IND.
OHIO
W.VA.
MD.
DEL.
COLO.
MO.
KANS.
KY.
VA.
N.C.
ARIZ.
N.MEX.
OKLA.
TEX.
ARK.
TENN.
S.C.
MISS.
ALA.
GA.
LA.
FLA.
● Non-EDA County
★ EDA County

Exhibit V-6. Counties with Two or More 'Small' Canning or Freezing Plants (Approximate Actual County Locations), 1970.

To gain further insight into the absolute levels of small plants by various locations within the U.S., a final summary of actual numbers of small plants by census region is shown in Exhibit V-7. This presentation emphasizes that substantial impacts can be expected in the East North Central and Pacific Regions regardless of the fact that small plants are of lower relative consequence in these regions.

Many additional analyses could be performed to further pinpoint anticipated problem areas. Depending on the courses of action planned by CEQ, other analyses may be quite important for the fruit and vegetable canning and freezing industries. To assist in any further analyses, a Statistical Supplement (Part IV of this Report series) has been prepared. Additional information is needed, however, before impacts on any one of the identified 1188 processing plants can be accurately assessed.

As a final guide to the type of information available in the Statistical Supplement, which might be readily used for further specific analyses, a summary of the tabulated data available is presented in Table V-9. This information is available for all plants by county within 478 counties throughout the United States.

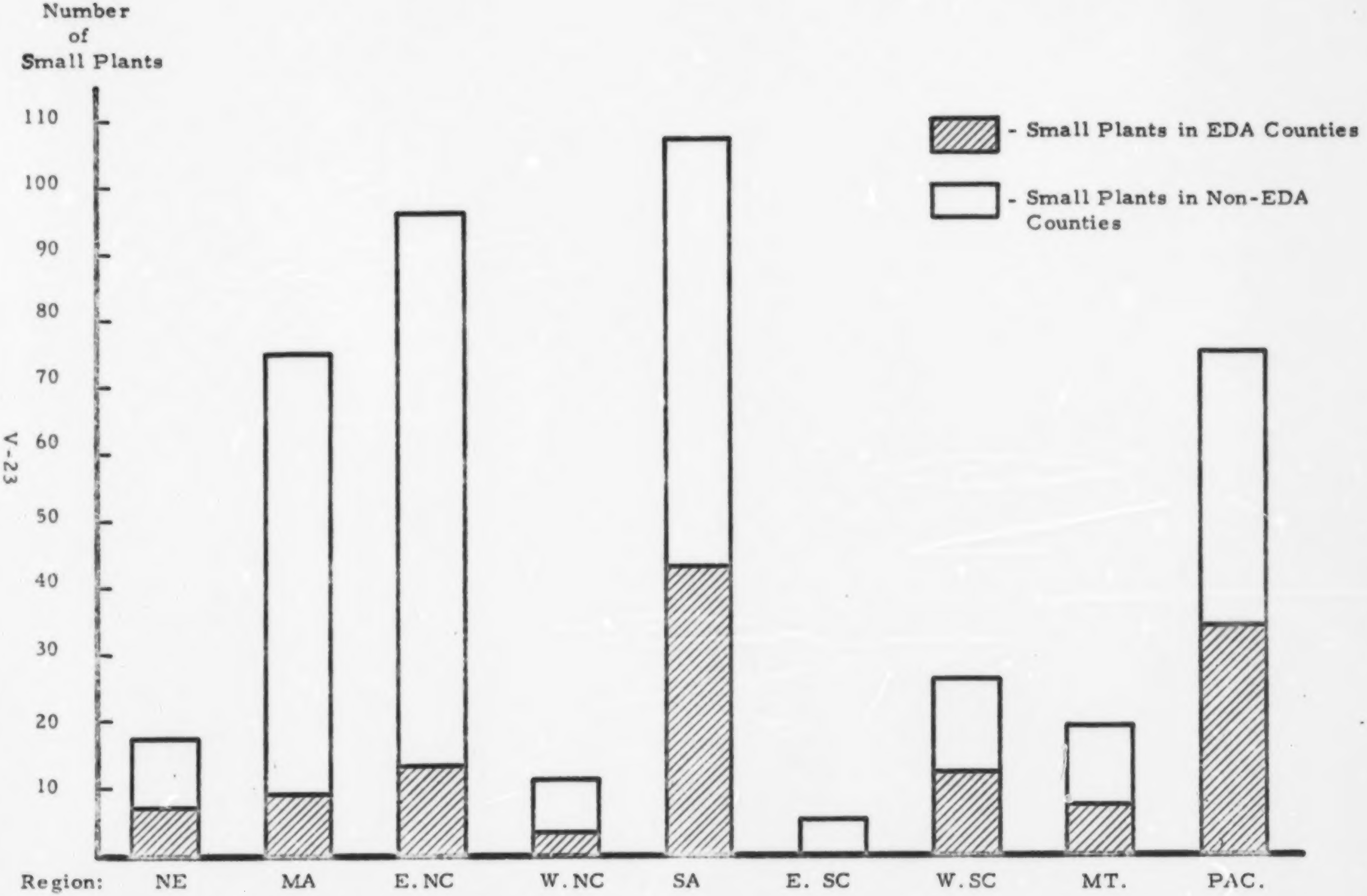

Exhibit V-7. Actual Numbers of 'Small' Plants (in EDA and Non-EDA Counties), by Census Region, 1970

Table V-9. Summary of Tabulated Data for a Selected County (Dorchester, Maryland), Canning and Freezing Plants, 1970

Dorchester County, Maryland				
Tabulated Data		Code	Description	
(1)	Census Region	5	South Atlantic	
(2)	State	23	Maryland	
(3)	County	10	Dorchester	
(4)	Economic Region	01	Atlantic Metro. Belt	
(5)	Economic Subregion	15	S. Jersey Cst, Delmawa Penin. and Virginia Penins.	
(6)	EDA County?	1	Yes	
(7)	Total No. Plants	C [1]	10	
(8)	Type of Plant Distribution	C	Number Plants	
	Can		10	
	Freeze		0	
	Both		0	
(9)	Plant Size Class Distr.	C	Number	Percent
	Small		9	90
	Medium		0	0
	Large		1	10
(10)	Type of Product Distr.	C	Number Plants	
	Vegetable		9	
	Fruit		0	
	Both		1	
(11)	Type of Firm Distr.	C	Number Plants	
	1 Plant		9	
	2-5 Plants		0	
	Over 5 Plants		1	
(12)	No. Products Distr.	C	Number Plants	
	1 Product		7	
	2-5 Products		3	
	Over 5 Products		0	

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[1] C = Calculated for all plants in county.

PRIMARY SOURCES

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APPENDIX TABLES

Table A-1. Estimated Investment and Operating Costs for In-Plant Liquid Handling and Treatment Facilities, NCA Survey

Plant Size	No. of Cases		Raw Product	In-Plant		Treatment	
	Hours	Year	Tonnage/Yr	Total Capital	Annual O&M	Total Capital	Annual O&M
Small	100	50,000	1,000	$ 900	$ 70	$ 11,800	$ 160
Medium	250	187,500	3,750	$ 3,375	$ 263	$ 44,250	$ 600
Large	1,000	1,000,000	20,000	$18,000	$1,400	$236,000	$3,200

(Note: All costs are assumed by NCA to be low)

Source: National Canners Association

Table A-2. Basic Data for Cash Flow Construction

Product: Sweet Corn and Green Peas Type: Canning

Source: Robert Reed, A Synthesis of Operation, Costs and Return for Sweet Corn and Green Pea Canning Plants in Wisconsin and Minnesota, University of Wisconsin, 1967.

	Unit	Plant I	Plant II	Plant III
Capacity/hr	303			
Corn		100	400	1,200
Peas		100	170	1,000
Total		200	570	2,200
Length of Season	Hrs.	500	750	1,000
Hours/day		8	8	10
Total Capacity	303 Eq			
Corn		50,000	300,000	1,200,000
Peas		50,000	127,500	1,000,000
Total Cases		100,000	427,500	2,200,000
Fixed Investment				
Inv. cost/case/hr corn 1/		$ 2,200	$ 1,913	$ 1,320
Total corn		220,000	765,200	1,584,000
Inv. cost/case/hr Peas 1/		2,100	2,020	1,375
Total Peas		210,000	343,000	1,375,000
Total Plant		$430,000	$1,108,200	$2,959,000

1/ From Exhibit 1

Fixed Investment (cont)		Plant I	Plant II	Plant III
Adjustment Required	120	$516,000	$1,329,600	$3,550,800
Equipment Cost (Percent)		70	70	71
Total Equipment		361,200	930,720	2,521,000
Replacement Cost 33.3% every 5 yrs.		120,000	310,000	839,000

Table A-2 (continued)

Variable Cost

Basis

Corn: Actual 1018 cases/hr = $1.92/case
Peas: Actual 1333 cases/hr = $1.95/case

Corn Index	110	107	100
Pea Index	109	108.4	102.4
Corn estimated	$2.112	$2.054	$1.92
Pea estimated	2.125	2.114	1.997
Corn adjusted	2.530	2.460	2.300
Pea adjusted	2.550	2.540	2.400
Total Variable Costs			
Corn (120)	126,500	738,000	2,760,000
Peas (120)	127,500	323,850	2,400,000
Total	254,000	1,062,000	5,160,000
Working Capital 33.3 percent	84.6	353.6	1,718.2

Revenue	Plant I	Plant II	Plant III
Average annual prices from canning trade Ex Std 24/303 (Peas 3 SV and 4SV)			
Peas Volume	50,000	127,000	1,000,000
@ $3.65/case	$182,500	$463,500	$3,650,000
Corn	50,000	300,000	1,200,000
@ $3.40/case	$170,000	$1,020,000	$4,080,000
Total	$353,000	$1,484,000	$7,730,000
Waste Water			
Corn Cases/day	800	3,200	12,000
@ 54 gal/case	43,200	172,800	648,000
Peas Cases/day	800	1,360	10,000
@ 51 gal/case	40,800	69,360	510,000
Total gal/day	84,000	242,000	1,158,000
Adjusted flow (1.5157)	127,000	367,000	1,755,000

Table A-3. Calculation for Increased Plant Capacity

Product: Corn and Peas **Type:** Canning

Assumption: Assume same throughput as original plant, but plant capacity is increased by 25 percent reflecting operation at less than capacity.

	Plant I	Plant II	Plant III
Increased Capacity/hr.			
Corn (303 Eg)	125	500	1,500
Peas (303 Eg)	125	212	1,250
Investment Cost			
Per Case per hour			
Corn	$ 2,175	$ 1,850	$ 1,200
Peas	2,075	2,000	1,300
Total Investment			
Corn	$271,875	$ 925,000	$1,800,000
Peas	259,375	425,000	1,625,000
Total	$531,250	$1,350,000	$3,425,000
Adjustment for inflation	$637,500	$1,620,000	$4,110,000
Percent machinery investment	70	70	71
Machinery investment	$446,250	$1,134,000	$2,918,000
Replacement Value	$148,601	$ 377,622	$ 971,694
Operating Cost			
At 100% capacity	$254,000	$1,062,000	$5,160,000
At 75% capacity (1.053)	$267,000	$1,118,000	$5,433,000
Working Capital			
33.3 percent	$ 89,000	$ 372,000	$1,809,000

Table A-3 (continued)

Waste Treatment			
Maximum Flow gal/day (000)	105	303	1,448
Adjusted Flow (1.5157)	159	459	2,195
Fixed Investment	280,000	495,000	1,160,000
Operating Capital	14,000	30,000	100,000

Table A-4. Basic Data for Cash Flow Construction

Product: Single Strength Orange Juice **Type:** Canned

Source: A.H. Spurlock, Costs of Processing, Warehousing and Selling Florida Citrus Products, 1969-70 Season. Dept. of Econ., University of Florida, Gainesville

Length of Season (hrs.)

Average pack = 414,000 cases
Assume: 4-5 month season
120-150 day at 8 hrs. = 960 - 1200 hours
Therefore assume 1000 hr season for all plants

	Plant I	Plant II	Plant III
Capacity/hr			
75 percent 12/46 oz			
25 percent 24/2 oz	200	400	1,000
Average volume per Spurlock was 414,000 cases			
Hours per day	8	8	8
Total pack cases	200,000	400,000	1,000,000

Fixed Investment

Fixed cost was not given, therefore, the fixed cost was estimated from data relating to similar type plants (See Exhibit 1 and 1A). Data based on 1970 prices.

	Plant I	Plant II	Plant III
Based on hourly case capacity	$ 1,450	$ 1,230	$ 1,020
Total Fixed Investment	$290,000	$492,000	$1,020,000
Percent machinery invest.	70	70	71
Machinery Cost	$203,000	$344,400	$724,200
Replacement cost 33.3%	67,600	114,700	241,000

Table A-4 (continued)

Variable Cost See Exhibit II			
12/46 oz.			
Per Case	$2.153	$2.063	$1.972
Raw Product (Exhibit III)	1.12	1.12	1.12
Total	3.273	3.183	3.092
75% of total cases	150,000	300,000	750,000
Total 12/46 oz	$490,950	$954,900	$2,319,000
24/2 oz.			
Per Case	$2.06	$1.97	$1.88
Raw Product Exhibit III	1.12	1.12	1.12
	3.18	3.09	3.00
25% Total Cases	50,000	100,000	250,000
Total	159,000	309,000	750,000
Total Variable Cost	$650,000	$1,264,000	$3,069,000
Working Capital			
33.3 Percent	$216,000	$421,000	$1,022,000
Revenue			
Annual average from Canning Trade Exhibit 4			
Case 12/46 oz $3.50	$525,000	1,050,000	2,625,000
Case 24/ 2 oz $3.08	154,000	308,000	770,000
	$679,000	1,358,000	3,395,000
Waste Water (Exhibit 5)			
Cases per day	1,600	3,200	8,000
Gallons/day 40 gal/case	64,000	128,000	320,000
Adjusted 1,5157	97,000	194,000	485,000
Fixed Cost	218,000	308,000	500,000
Variable Cost	10,000	16,000	30,000

Table A-5. **Basic Data for Cash Flow Construction**

Product: Tomatoes **Type:** Canning

Source: Gene A. Mathia, James L. Pearson and Ofelia Ela, An Economic Analysis of Whole Tomato Canning Opportunities in the South, 1970.

	Plant I	Plant II	Plant III
Length of Season (hrs.)			
Hours	500	750	1,000
Capacity			
303 Case/hr.	140	300	600
Hours/day	8	8	10
Total Pack 303 eq	70,000	225,000	600,000
Fixed Investment			
Estimated from Source Listed above	145,000	275,000	510,000
Adjusted for Inflation(116)	168,000	319,000	592,000
Percent invested in Equip.	70	65	55
Total Equipment	118,000	207,000	326,000
Replacement (33.3 percent)	39,000	68,000	108,000
Operating Cost			
Cost per case (1968 value)	$ 3.55	$ 3.20	$ 2.90
Total operating cost	$248,500	$720,000	$1,740,000
Adjusted (1968-1971) 116	$288,000	$835,000	$2,018,000
Working Capital			
33.3 percent O.C.	$ 96,000	$278,000	$672,000

Table A-5 (continued)

Revenue

Revenue based upon average monthly prices for 1970-71 from Canning Trade.

Percent	Size	Price	Conversion	Price 1971 303 Eg	Price Weighted Average
50	303	$4.20	1.0	$4.20	
25	2 1/5	$5.92	1.77	$3.34	
25	10	$4.89	1.62	$3.02	$3.70

Total pack (24/303 only)	70,000	225,000	600,000
Total revenue	$294,000	$833,000	$2,220,000

Waste Water

59 gal. per case

Cases per day	1,120	2,400	6,000
Gallons/day	66,000	142,000	354,000
Adjusted flow (1.515)	100,000	215,000	536,000

Table A -6. Basic Data for Cash Flow Construction

Product: Sweet Potatoes **Type:** Canning

Source: Hammond, Leigh H. and King, Richard A., The Feasibility of Expanding Sweet Potato Canning in the South, 1963.

Capacity/hr	Unit	Plant I	Plant II	Plant III	Plant IIIa	Plant IV
Full	24/303	80	280	760	760	1,013
Assumed	"	80	280	760	570	760
Length of Season	Hrs.	500	750	1,000	1,000	1,000
Hours/day		8	8	8	8	8
Total Capacity	303 Eq	40,000	210,000	760,000	570,000	760,000
Fixed Investment						
Total		$245,000	$330,000	$565,000	$565,000	$665,000
Adjustment (136.8)		335,000	451,000	773,000	773,000	910,000
Equipment Cost		235,000	316,000	541,000	541,000	637,000
Replacement Cost (33.3%)		78,000	105,000	180,000	180,000	213,000
Variable Costs						
Total	Thous.	$165	$575	$1,875	$1,431	$1,955
Adjustments (136.8)	"	$226	$787	$2,565	$2,026	$2,675
Working Capital (33.3%)	"	$ 75	$262	$855	$675	$892
Revenue ($4.31/case 24/303)						
Total	Thous.	$172	$905	$3,276	$2,457	$3,276
Waste Water						
Cases/day		640	2,240	6,080	4,560	6,080
@ 90 gal/case		58,000	202,000	547,000	410,400	547,000
Adjusted flow		88,000	306,000	829,000	621,000	829,000

Table A-6 (continued)

Working Capital (33.3%)		766,000
Revenue (adjusted to 1971 by using actual prices)		
Sweet Potatoes	192,000 @ 4.10	$ 787,000
Carrots	200,000 @ 2.74	548,000
Green Beans	309,000 @ 3.16	977,000
Leafy Greens	103,000 @ 2.86	295,000
Peaches	43,000 @ 4.33	186,000
		$2,693,000

Waste Water	
Sweet Potatoes	
Cases/day	4,402
@ 90 gal/case	396,000
Carrots	
Cases/day	8,000
@ 36 gal/case	288,000
Green Beans	
Cases/day	6,184
@ 40 gal/case	247,000
Leafy Greens	
Cases/day	3,440
@ 180 gal/case	619,000
Peaches	
Cases/day	2,416
@ 60 gal/case	145,000

Product Overlap (two products simultaneously)	
Leafy Greens-Green Beans	5 days
Leafy Greens-Carrots	10 days
Leafy Greens-Sweet Potatoes	5 days
Green Beans-Sweet Potatoes	20 days

Maximum Capacity Required

Leafy Greens and Sweet Potatoes = 1,014,000 gal/day

Adjusted 1,537,000

Table A-7. Basic Data for Cash Flow Construction

Product: Green Beans **Type:** Canning

Source: Gene A. Mathia and James L. Pearson, An Analysis of Opportunities for Canning Green Beans in the South. 1970

	Plant I	Plant II	Plant III
Length of Season (hrs.)	500	750	1,000
Capacity 303 case/hr	120	330	900
Hours/day	8	8	10
Total Pack 303 case	60,000	247,000	900,000

Fixed Investment

Used index method to estimate 100 = $852,000 for 800 cases per hour/1000 hr season (Exhibit 16)

a. Plant I (small)
120/500 ≩ (20%) ($852,000) = $170,000

b. Plant II (medium)
300/750 (46%) ($852,000) = $392,000

c. Plant III (Large)
900/1000 (110%) ($852,000) = $937,000

	Plant I	Plant II	Plant III
Adjustment for Inflation 116 [1]	197,000	455,000	1,087,000
Percent Inv. in Equipt. (see Exhibit 2)	45	44	41
Total Equipment	89,000	200,000	446,000
Replacement (33.3 percent)	30,000	67,000	149,000

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[1] GNP Inflation Series

Table A-7 (continued)

Operating Cost

Percent of "Base"	134	116.5	135
(Base" Plant = $2.63			
Estimated Cost/case	3.52	3.06	2.60
Total Operating Cost	$211,000	$757,000	$2,340,000
Adjustment 116	$245,000	$878,000	$2,714,000

Working Capital

33.3 Percent	$82,000	$292,000	$904,000

Revenue

Average [1] 303 price 3.29 ÷ 1 = 3.29 x .75 $\left.\begin{matrix}\\ \\ \end{matrix}\right\rangle$ 3.15
Average No. 10 price 4.30 ÷ 1.62 = 265 x .25
$3.15 blend price used for med and large plants
$3.30 303 price used for small plants
Assume L&M plants 75% - 25% S plant 100% 3.3

[1] Canning Trade see 4b

Total Pack	60,000	247,500	900,000
(24/303's eg) @	3.30	3.15	3.15
Total Revenue	$198,000	$780,000	$2,835,000

Waste Water

51 - 69 gal. per case - assume 60 gal.

Cases per day	960	2,640	9,000
Gallons per day	57,600	158,400	540,000
Adjusted flow (1.515)	87,300	240,000	818,000

Table A-8. Basic Data for Cash Flow Construction

Product: Sweet Potatoes, Carrots, Green Beans, Leafy Greens and Peaches

Type: Canning

Source: Hammond, Leigh H., et. al., The Feasibility of Producing and Processing Certain Vegetables in Southeastern North Carolina, 1967.

Capacity/hr	Unit	Plant I (cases)
Sweet Potatoes	24/303	549
Carrots	"	1,000
Green Beans	"	773
Leafy Green	"	430
Peaches	"	302
Length of Season	Hrs.	
Sweet Potatoes		350
Carrots		200
Green Beans		400
Leafy Greens		240
Peaches		144
Total		1,334
Hours/day		8
Total Capacity	24/303 Eq	
Sweet Potatoes		192,000
Carrots		200,000
Green Beans		309,000
Leafy Greens		103,000
Peaches		43,000
		847,000
Fixed Investment		
Total		$1,126,000
Adjustment (124.1)		1,398,000
Equipment Cost (percent)		70
Total Equipment		979,000
Replacement Cost 33.3% every 5 yrs.		326,000
Variable Cost		
Total		$1,852,000
Adjustment (124.1)		$2,298,000

Table A-8. (continued)

Working Capital (33.3%) $ 766,000

Revenue (adjusted to 1971 by using actual prices)

Sweet Potatoes	192,000 @ 4.10	$ 787,000
Carrots	200,000 @ 2.74	548,000
Green Beans	309,000 @ 3.16	977,000
Leafy Greens	103,000 @ 2.86	295,000
Peaches	43,000 @ 4.33	186,000
		$2,693,000

Waste Water

Sweet Potatoes	
Cases/day	4,402
@ 90 gal/case	396,000
Carrots	
Cases/day	8,000
@ 36 gal/case	288,000
Green Beans	
Cases/day	6,184
@ 40 gal/case	247,000
Leafy Greens	
Cases/day	3,440
@ 180 gal/case	619,000
Peaches	
Cases/day	2,416
@ 60 gal/case	145,000

Product Overlap (two products simultaneously)

Leafy Greens-Green Beans	5 days
Leafy Greens-Carrots	10 days
Leafy Greens-Sweet Potatoes	5 days
Green Beans-Sweet Potatoes	20 days

Maximum Capacity Required

Leafy Greens and Sweet Potatoes = 1,014,000 gal/day

Adjusted flow 1,537,000

Table A-9. Basic Data for Cash Flow Construction

Product: Frozen Orange Juice Concentrate Type: Freezing

Source: A. H. Spurlock, Cost of Processing Warehousing and Selling Florida Citrus Products 1969-70 Season, Dept. of Ag. Econ., Univ. of Florida, Gainesville.

	Plant I	Plant II	Plant III
Length of Season (hrs.)	1,000	1,000	1,000
Capacity/hr.	200	700	1,500
Average plant production 716,000 cases			
Hours per day	8	8	8
Total Pack	200,000	700,000	1,500,000
Fixed Investment			
Fixed Investment estimated from data relating to similar type plants (See Exhibit 1 and 1A SS folders) Single strength Orange Juice basis plus 30 percent. (Data based on 1970 prices.)			
Fixed Investment/case/hr	1,885	1,417	1,274
Total Investment/plant	377,000	991,900	$1,911,000
Plus 50 percent			
Fixed Investment/case/hr	2,175	1,635	1,470
Total Investment/plant	435,000	1,144,500	2,205,000
Percent machinery Inv.	70	70	71
Machinery Cost	$305,000	$801,000	$1,565,000
Replacement Cost 33.3%	$102,000	$267,000	$521,000
Variable Cost			
Variable Cost/case	2.47	2.38	2.27
Selling Expense	.122	.122	.122
Raw Product (Exhibit 1)	.93	.93	.93
Picking and Hauling (Exhibit 1)	1.17	1.17	1.17
Total variable cost/case	4.692	4.602	4.492
Total variable cost	$938,000	$3,221,000	$6,738,000

Table A-9 (continued)

Working Capital			
33.3 percent	$312,000	$1,073,000	$2,245,000
Revenue			
Average price 1969-70 season = $5.88/case			
Source: Florida Citrus Commission, Exhibit 2			
	1,176,000	4,116,000	8,820,000
Waste Product			
1 case = 72 gal waste water			
Cases/day	1,600	5,600	15,000
Gal Waste per day	115,000	403,200	1,080,000
At 25% increase capacity	2,000	7,000	18,750
Gal waste per day	144,000	504,000	1,350,000
Adjusted 1.5157	217,000	759,000	2,032,000
Fixed Investment	330,000	645,000	1,100,000
Variable Cost	18,000	44,000	95,000

Table A-10. Calculations for Increased Plant Capacity

Product: Orange Juice Concentrate **Type:** Freezing

Assumption: Assume some throughput as original plant but plant capacity is increased by 25 percent reflecting operation at less than capacity.

	Plant I	Plant II	Plant III
Increased Capacity			
Cases per hour	250	875	1,875
Revised Fixed Investment			
Investment per case per hour	$ 1,380	$ 1,040	$ 970
Plus 50 percent adjusted	2,070	1,560	1,455
Estimated Fixed Investment	$518,000	$1,365,000	$2,728,000
Machinery Value	$362,000	$ 956,000	$1,936,000
Replacement Value	$121,000	$ 318,000	$ 645,000
Operating Cost			
Adjusted (1.053)	$988,000	$3,392,000	$7,095,000
Working Capital	$329,000	$1,130,000	$2,363,000
Waste Water			
Cases per day	2,000	7,000	18,750
Gal. waste per day	144,000	504,000	1,350,000
Adjusted (1.5157)	217,000	759,000	2,032,000
Fixed Investment	$330,000	$ 645,000	$1,100,000
Variable Cost	$ 18,000	$ 44,000	$ 95,000

Table A-11. Basic Data for Cash Flow Construction

Product: Green Beans, Carrots, Leafy Greens Type: Freezing

Source: Hammond, Leigh H., *et al.*, The Feasibility of Producing and Processing Certain Vegetables in Southeastern North Carolina, 1967.

Capacity/hr	Unit	Plant I (1 shift)	Plant II (2 shifts)
Green Beans	Tons	7.5	7.5
Carrots	"	6.5	6.5
Leafy Greens	"	4.0	4.0
Length of Season	Hrs.	840	1,680
Green Beans		400	800
Carrots		200	400
Leafy Greens		240	480
Hours/day	Hrs.	8	16
Total Capacity			
Green Beans	Thous. lbs.	5,100	10,200
Carrots	" "	1,430	2,860
Leafy Greens	" "	1,344	2,688
Fixed Investment			
Total		$1,809,000	$1,809,000
Adjustment (124.1)		2,245,000	2,245,000
Equipment Cost		1,453,000	1,453,000
Replacement Cost 33.3% every 5 yrs.		484,000	484,000
Variable Cost			
Total		$1,257,000	$2,379,000
Adjustment (124.1)		1,560,000	2,952,000
Working Capital (33.3%)		$ 520,000	$ 984,000
Revenue			
Total		$1,426,000	$2,850,000
Adjustment (117.7)		1,678,000	3,356,000

Table A-11 (continued)

Waste Water

Product	Cases/ hr.	Cases/ day	Gal/ case	Total Water Per Day
Green Beans	518	4, 144	41	169, 000
Carrots	291	2, 328	36	83, 808
Leafy Greens	251	2, 008	180	361, 400
				614, 208

1 shift plant 614, 208 gal, adjusted = 931, 000 gal/day
2 shift plant 1, 228, 000 gal, adjusted = 1, 862, 000 gal/day

Table A-12. Internal Rates of Return for Various Plants to Demonstrate Sensitivity to Pollution Abatement Costs

Plant	Plant Size	Percent Capacity	Price Level (Percent)	Pollution Abatement Cost			
				Without (Target-100)	Plus 30%	Target	Minus 30%
Canned Corn and Peas	L	75	0	50.33	32.44	35.54	39.15
			1	XX	34.40	37.70	41.53
			5	XX	42.81	46.99	51.91
			10	XX	54.84	60.45	67.14
	M	75	0	18.23	9.81	11.35	13.09
			1	XX	10.69	12.29	14.09
			5	XX	14.24	16.06	18.14
			10	XX	18.73	20.89	23.40
	S	75	0	7.39	- .83	- .70	- 2.39
			1	XX	- .20	1.34	3.05
			5	XX	2.17	3.79	5.61
			10	XX	4.95	6.69	8.69
Canned SS Orange Juice	L	100	0	16.36	9.05	10.40	11.92
			1	XX	10.81	12.27	13.92
			5	XX	18.04	20.02	22.31
			10	XX	27.92	30.81	34.23
	M	100	0	8.00	1.35	2.50	3.96
			1	XX	2.97	4.29	5.76
			5	XX	9.27	10.97	12.93
			10	XX	17.17	19.55	22.40
	S	100	0	.5	- 5.03	- 3.82	- 2.51
			1	XX	- 3.46	- 2.22	- .85
			5	XX	2.26	3.74	5.44
			10	XX	8.78	10.71	
Canned Tomatoes	L	100	0	16.43	6.13	8.07	10.21
			1	XX	8.28	10.29	12.54
			5	XX	16.46	18.96	21.86
			10	XX	26.96	30.46	34.63
Canned Corn & Peas W/Low Investment High Operating Cost Facility	M	75	0	18.23	9.47	11.26	13.16
			1	XX	10.48	12.30	14.24
			5	XX	14.52	16.49	18.63
			10	XX	19.68	21.91	24.37

(continued)

Table A-12. Internal Rates of Return for Various Plants to Demonstrate Sensitivity to Pollution Abatement Costs (continued)

Plant	Plant Size	Percent Capacity	Price Level	Pollution Abatement Cost			
				(Target-100)	Plus 30%	Target	Minus 30%
			(Percent)				
Canned Sweet Potatoes	L	75	0	39.09	14.42	17.70	21.88
			1	XX	15.97	19.46	23.94
			5	XX	22.41	26.88	32.84
			10	XX	31.18	37.29	-
Multiproduct Canning	L	100	0	17.68	4.59	6.74	9.25
			1	XX	5.83	8.06	10.69
			5	XX	10.69	13.33	16.53
			10	XX	16.78	20.10	24.26
Frozen Orange Juice Concentrate	L	7	0	49.04	30.60	33.74	37.41
			1	XX	33.06	36.45	40.43
			5	XX	43.80	48.41	53.91
			10	XX	59.81	66.54	74.75
	M	75	0	38.53	22.93	25.54	28.61
			1	XX	24.94	27.75	31.08
			5	XX	33.57	37.35	41.89
			10	XX	46.02	51.43	58.06
	S	75	0	25.64	11.91	14.10	16.70
			1	XX	13.32	15.63	18.41
			5	XX	19.06	21.99	25.60
			10	XX	26.72	30.65	35.62
Multiproduct Freezing	L	75	0	8.46	2.12	3.35	4.70
			1	XX	3.40	4.68	6.08
			5	XX	8.36	9.87	11.56
			10	XX	14.5	16.40	-
Canned Corn & Peas W/Municipal Facilities	L	75	0	50.33	37.28	39.78	42.55
			1	XX	39.56	42.22	45.17
			5	XX	49.45	52.85	56.65
			10	XX	63.85	68.48	73.71
	M	75	0	18.23	13.75	14.68	15.68
			1	XX	14.80	15.77	16.80
			5	XX	19.09	20.20	21.39
			10	XX	24.69	26.03	27.46

(continued)

Table A - 12.1 Internal Rates of Return for Various Plants to Demonstrate Sensitivity to Pollution Abatement Costs (continued)

Plant	Plant Size	Percent Capacity	Price Level	Pollution Abatement Cost (Target-100)	Plus 30%	Target	Minus 30%
Canned	S	75	0	7.39	4.75	5.33	5.92
Corn &			1	XX	5.48	6.06	6.67
Peas			5	XX	8.33	8.95	9.60
W/Municipal			10	XX	11.81	12.51	13.23
Facilities							
Canned SS	L	100	0	16.78	12.77	13.61	14.49
Orange Juice			1	XX	14.87	15.78	16.74
W/Municipal			3	XX	19.22	20.28	21.41
Facilities			10	XX	23.79	25.04	26.38
	M	100	0	8.00	5.19	5.80	6.43
			1	XX	7.15	7.79	8.47
			5	XX	15.10	15.95	16.86
			10	XX	25.93	27.18	-

Table A-13. Summary of Internal Rates of Return for Representative Freezing Plants

Plant	Plant Size	100 Percent Capacity		75 Percent Capacity	
		Without Treatment	With Treatment	Without Treatment	With Treatment
Frozen orange juice concentrate	S	62.7	36.8	0.0	0.0
	M	78.0	67.7	33.4	28.5
	L	80.4	68.3	46.0	39.4
Multiproduct Plant (Green beans, Carrots, Leafy Greens)	M	Neg	Neg		
	L	9.5	7.5		

Table A-14. Summary of Internal Rates of Return for Multiproduct Corn and Peas Canning Plant as Related to Level of Technology

Plant Size	Level of Technology	100% Capacity		75% Capacity	
		Without Treatment	With Treatment	Without Treatment	With Treatment
Small	New	13.6	6.7	4.9	-0.2
	Prevalent	18.5		6.1	-0.6
	Old	18.4		5.0	-1.8
Medium	New	26.0	20.1		
	Prevalent	23.8		10.7	7.3
	Old	21.1		5.5	2.2
Large	New	70.1	63.4	41.8	36.7
	Prevalent	62.0		33.0	28.7
	Old	63.4		29.2	24.7

Table A-15. Selected Data for Counties with Two or More 'Small' Canning or Freezing Plants, by Census Region and State, 1970

Census Region, State and County	EDA Co.?	Number of Plants			Type of Plant			Type of Product		
		Small	Medium	Large	Can	Freeze	Both	Veg.	Fruit	Both
New England										
Maine										
Hancock	No	6	0	0	2	3	1	0	6	0
Knox	Yes	3	1	0	1	2	1	0	3	1
Washington	Yes	2	1	0	2	0	1	0	3	0
Region Totals		11	2	0	5	5	3	0	12	1
Middle Atlantic										
New York										
Chautauqua	No	4	2	2	6	1	1	1	6	1
Erie	No	5	3	0	5	0	3	8	0	0
Monroe	No	2	1	2	3	2	0	1	1	3
Niagara	No	5	1	0	4	2	0	0	3	3
Ontario	No	6	1	3	10	0	0	10	0	0
Orleans	Yes	3	1	1	3	2	0	1	4	0
Wayne	No	13	4	5	10	5	7	4	13	5
New Jersey										
Cumberland	Yes	5	3	4	10	2	0	4	3	5
Pennsylvania										
Berks	No	2	3	0	5	0	0	4	1	0
Chester	No	6	6	0	8	0	4	12	0	0
Erie	No	2	1	1	1	1	2	0	2	2
Lancaster	No	2	0	0	0	1	1	2	0	0
Region Totals		55	26	18	65	16	18	47	33	19

Table A-15 (continued) /

Census Region, State and County	EDA Co. ?	Number of Plants			Type of Plant			Type of Product		
		Small	Medium	Large	Can	Freeze	Both	Veg.	Fruit	Both
East North Central										
Ohio										
Putnam	No	2	1	1	4	0	0	4	0	0
Williams	No	2	0	0	2	0	0	2	0	0
Indiana										
Blackford	No	2	0	0	2	0	0	2	0	0
Grant	No	3	0	2	5	0	0	5	0	0
Welk	No	2	0	0	2	0	0	2	0	0
Illinois										
Cook	No	5	3	1	7	0	2	5	2	2
Michigan										
Berrien	No	5	6	2	3	3	7	3	4	6
Eaton	No	2	0	0	2	0	0	2	0	0
Grand Traverse	Yes	2	2	0	1	0	3	0	4	0
Lenawee	No	3	0	0	2	0	1	1	0	2
Manistee	Yes	2	1	0	1	0	2	0	3	0
Van Buren	No	7	2	3	4	3	6	1	8	4
Wisconsin										
Brown	Yes	3	2	2	5	0	2	5	1	1
Dodge	No	3	1	4	6	0	2	6	0	2
Door	No	3	1	0	1	2	1	0	3	1
Sauk	No	2	1	0	3	0	0	3	0	0
Wood	No	2	1	0	3	0	0	3	0	0
Region Totals		50	21	15	53	8	26	44	25	18
West North Central					None					

Table A-15 (continued) -2

Census Region, State and County	EDA Co. ?	Number of Plants			Type of Plant			Type of Product		
		Small	Medium	Large	Can	Freeze	Both	Veg.	Fruit	Both
South Atlantic										
Delaware										
Kent	No	3	0	1	3	0	1	4	0	0
New Castle	No	2	1	0	3	0	0	3	0	0
Sussex	Yes	6	4	0	4	2	4	9	0	1
Maryland										
Baltimore	No	2	2	1	4	0	1	3	2	0
Caroline	No	3	2	0	4	1	0	5	0	0
Carroll	No	4	0	0	4	0	0	4	0	0
Dorchester	Yes	9	0	1	10	0	0	9	0	1
Harford	No	3	1	0	3	1	0	4	0	0
Somerset	Yes	2	1	0	3	0	0	3	0	0
Talbot	No	2	5	0	6	1	0	7	0	0
Worcester	No	6	1	0	7	0	0	7	0	0
Virginia										
Northampton	No	4	0	0	3	1	0	4	0	0
Page	No	2	0	0	2	0	0	1	1	0
Westmoreland	Yes	2	0	0	2	0	0	2	0	0
West Virginia										
Morgan	Yes	2	0	0	2	0	0	2	0	0
South Carolina										
Greenville	No	2	0	0	1	1	0	0	1	1
Georgia										
Grady	No	2	0	0	2	0	0	2	0	0
Florida										
Dade	No	2	1	1	3	0	1	2	1	1
Hillsborough	No	3	4	1	6	1	1	2	3	3
Orange	No	2	3	1	0	2	4	0	6	0
Polk	Yes	7	4	7	5	6	7	1	17	0
Region Totals		70	29	13	77	16	19	74	31	7

Table A-15(ontinued) 3

Census Region, State and County	EDA Co. ?	Number of Plants			Type of Plant			Type of Product		
		Small	Medium	Large	Can	Freeze	Both	Veg.	Fruit	Both
East South Central					None					
West South Central										
Louisiana										
Orleans	No	2	1	0	3	0	0	1	1	1
St. Martin	Yes	2	1	0	3	0	0	2	0	1
Oklahoma										
Adair	Yes	2	1	0	2	0	1	2	0	1
Texas										
Hidalgo	No	3	5	1	5	1	3	5	0	4
Region Totals		9	8	1	13	1	4	10	1	7
Mountain										
Idaho										
Payette	Yes	2	1	0	2	0	1	1	1	1
Colorado										
Otero	No	2	2	0	3	1	0	1	0	3
Utah										
Utah	Yes	2	0	0	0	0	2	0	0	2
Weber	No	3	0	0	2	0	1	0	0	3
Region Totals		9	3	0	7	1	4	2	1	9
Pacific										
Washington										
Pierce	Yes	2	3	0	0	4	1	1	4	0
Snohomish	Yes	4	1	3	1	7	0	4	4	0
Yakima	Yes	2	4	8	10	3	1	3	7	4

Table A-15(continued) 4

Census Region, State and County	EDA Co.?	Number of Plants			Type of Plant			Type of Product		
		Small	Medium	Large	Can	Freeze	Both	Veg.	Fruit	Both
Pacific (continued)										
Oregon										
Jackson	Yes	3	0	0	3	0	0	0	3	0
Marion	No	6	5	8	5	6	8	4	5	10
Wasco	Yes	2	0	0	2	0	0	0	2	0
California										
Alameda	No	3	0	9	12	0	0	2	4	6
Butte	Yes	2	0	3	5	0	0	0	4	1
Fresno	Yes	4	2	2	5	2	1	0	6	2
Los Angeles	No	4	10	2	9	4	3	5	6	5
Monterey	No	3	1	2	1	3	2	5	1	0
Riverside	No	3	1	1	4	1	0	0	3	2
San Bernardino	No	4	0	1	4	0	1	0	3	2
San Francisco	No	3	0	1	2	0	2	2	1	1
San Joaquin	Yes	2	0	8	10	0	0	3	1	6
Santa Clara	No	3	5	12	16	3	1	6	7	7
Santa Cruz	Yes	4	7	7	6	6	6	5	9	4
Region Totals		54	39	67	95	39	26	40	70	50